Circular economy in construction and demolition waste management: an in-depth review and future perspectives in the construction sector

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Abstract

Purpose – This study aims to present state-of-the-art research on circular economy (CE) implementation in construction and demolition waste management (CDWM) within the construction sector.

Design/methodology/approach – A mixed-method (scientometric and critical analysis) review strategy was adopted, involving scientometric and critical analysis to uncover the evolutionary progress within the research area, investigate key research themes in the field, and explore ten issues of CE in CDWM. Moreover, avenues for future research are provided for researchers, practitioners, decision-makers, and planners to bring innovative and new knowledge to this field.

Findings – A total of 212 articles were analyzed, and scientometric analysis was performed. The critical analysis findings reveal extensive use of surveys, interviews, case studies, or mixed-method approaches as study methodologies. Furthermore, there is limited focus on the application of modern technologies, modeling approaches, decision support systems, and monitoring and traceability tools of CE in the CDWM field. Additionally, no structured framework to implement CE in CDWM areas has been found, as existing frameworks are based on traditional linear models. Moreover, none of the studies discuss readiness factors, knowledge management systems, performance measurement systems, and life cycle assessment indicators.

Practical implications – The outcomes of this study can be utilized by construction and demolition sector managers, researchers, practitioners, decision-makers, and policymakers to comprehend the state-of-the-art, explore current research topics, and gain detailed insights into future research areas. Additionally, the study offers suggestions on addressing these areas effectively.

Originality/value – This study employs a universal approach to provide the current research progress and holistic knowledge about various important issues of CE in CDWM, offering opportunities for future research directions in the area.

Keywords Circular economy, Construction and demolition waste management, Construction sector, Waste management

Paper type Literature review

1. Introduction

The construction and demolition industry (CDI) is a crucial sector that significantly contributes to the socio-economy growth (Mhlanga *et al.*, 2022). Globally, it accounts for approximately 7% of job opportunities and contributes around 25% to the gross domestic

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product (GDP) (Norouzi *et al.*, 2021). In the Middle East alone, the CDI employs over 13 million people and plays a key role in rapid urbanization, generating approximately $600bn annually with an average annual growth rate of 3–4%. However, the sustainability of this industry is challenged by the extensive generation of waste and carbon dioxide emissions compared to other sectors (Mahpour, 2018). Its unsustainable nature is rooted in its traditional linear approach of "Take, Make, and Dispose" (Mahpour, 2018). This approach leads to the disposal of raw materials used in construction without considering their end-of-life implications (Esa *et al.*, 2017; Huang *et al.*, 2018). Consequently, concerns have arisen among construction professionals, decision-makers, planners, scholars, and governments regarding the depletion of natural resources and environmental consequences (Ruiz *et al.*, 2020). In response, the CE has emerged as a model promoting reduce, reuse, refurbish, repair, and recycle approaches, thereby extending the life span of resources and mitigating environmental concerns (Mahpour, 2018).

While the adoption of CE principles has been widespread in various sectors, including utilities, basic materials, telecommunications, oil and gas, consumer service, and finance (García-Sánchez *et al.*, 2021), its application in construction and demolition sector is relatively nascent (Oluleye *et al.*, 2022). As a result, several definitions of CE have emerged in the literature. For example, Bressanelli *et al.* (2021) describe it as an approach that reconfigures current methods of production or resource usage to enhance efficiency and attain a sustainable environment. Bilal *et al.* (2020) view CE as an effective approach to solve linear economy problems. Ellen MacArthur Foundation (2015) defines it as an effective method to promote cleaner production and sustainable consumption through treating, reusing, and recycling wastes. Previous studies have not clearly elaborated on the definitions of construction and demolition waste management. Therefore, this study spotlighting its definition as "Construction and demolition waste management (CDWM) refers to the process of effectively handling, disposing of, and recycling the waste materials generated from renovation, construction, and demolition activities. CDWM includes implementing strategies to minimize waste generation, segregating and sorting materials for reuse or recycling, and ensuring proper disposal of non-recyclable waste in a manner that minimizes environmental impact".

Moreover, recent years have witnessed a growing recognition of the benefits of CE in CDI, such as enhanced resource efficiency, cost savings, customer engagement, resilience, security, and sustainability (Huang *et al.*, 2018). Despite, these advancements, the adoption of CE practices in CDI remains at an early stage (Cristiano *et al.*, 2021). Effective implementation of CE in CDI holds the potential to optimize resource recovery, minimize construction and demolition waste (CDW), ensure regulatory compliance, assess environmental impact, support decision-making, foster stakeholder collaboration, and drive continuous improvement in CDW management (Illankoon and Vithanage, 2023; Mhlanga *et al.*, 2022). Therefore, there is a pressing need to embrace CE principles in CDI to manage construction and demolition wastes (CDWs) effectively and conserve resources for the long term. However, the increasing demand for CE adoption in CDW management has attracted researchers' attention, resulting in numerous existing publications.

While previous reviews on CE in construction and demolition areas offer valuable insights (see Table 1), there are still some knowledge gaps that need addressing. For example, the existing reviews is focused on either digital technologies, 3R strategies, general overview of CDWM, tools and techniques of CDWM, contribution on SDGs, CE frameworks, and general science mapping. There is no comprehensive state-of-the-art analysis of CE in CDWM using a mixed-method approach providing holistic knowledge and highlighting strong future research directions. Hence, there is an urgent need to fill these gaps by delving into a deeper understanding of the current research progress and gaining holistic knowledge about various important issues of CE in CDWM. Moreover, previous reviews have not

Table 1. Summary of previous review articles

Author(s)	Published journal	Period	Article considered	Database	Focus area	Applied methodology	Outcomes	Research gaps
Rodrigo *et al.* (2024)	Smart and Sustainable Built Environment	Up to 2022	365	Web of Science	Digital technologies for CE in construction	Bibliometric, Text-mining, Content Analysis	Classified digital technologies into two categories	Focus solely on digital technologies
Illankoon and Vithanage (2023)	Journal of Building Engineering	2013–2022	78	Scopus and Web of Science	Development of CE in the Construction Sector	Descriptive, Bibliometric, Content Analysis	Classified CE literature into eight different themes	Need to determine the impact of greenhouse gas emissions and digital technologies in realizing the benefits of CE adoption
Soyinka *et al.* (2023)	Environment, Development and Sustainability	2000–2021	4,374	Web of Science	CDWM Overview from a Global Sustainability Perspective	Scientometric Review	Revealed active research on CDWM overview	Focused only on reducing, recycling, and reusing strategies
Soto-Paz *et al.* (2023)	Journal of Building Engineering	2010–2022	214	Scopus and Web of Science	Comparative analysis of CDWM in Emerging and Developed Countries	Bibliometric Analysis	Highlighted the role of eco-design in reducing CDW	Focused only on a general overview

(continued)

Table 1.

Author(s)	Published journal	Period	Article considered	Database	Focus area	Applied methodology	Outcomes	Research gaps
Gherman *et al.* (2023)	Recycling	2015–2021	72	Open Source Article	Circularity Outlines in the CDWM	Descriptive	Provided strategy, enablers, Barriers, computational tools, and building material development process in CDW management	Inadequate emphasis on educational mechanisms and tools
Zhang *et al.* (2023)	Journal of Environmental Management	1990–2022	303	Web of Science, Derwent Innovation Index	How CDWM has addressed SDGs	Descriptive, Bibliometric	Addresses trends in CDWM between the pre and post SDGs declaration era in academia and industry	Focus solely on industry and academia perspectives regarding how CDWM contributes to achieving SDGs
Rayhan and Bhuiyan (2023)	Waste Disposal & Sustainable Energy	Not mentioned	121	PubMed, Scopus, Web of Science	Tools and frameworks of CDWM	Descriptive	Highlighted the tools and frameworks to manage CDW	Focus solely on tools and frameworks
Papamichael *et al.* (2023)	Waste Management & Research	2019–2023	51	Scopus, Online sources	CE-based framework for CDW	Descriptive	Theoretical discussion on CE-based frameworks	Captured only CE-related frameworks

(*continued*)

Table 1.

Author(s)	Published journal	Period	Article considered	Database	Focus area	Applied methodology	Outcomes	Research gaps
Ismail (2023)	Engineering, Construction and Architectural Management	Up to 2021	20	Scopus and Web of Science	Existing issues in CE practices during movement control order	Descriptive	Described the Sophisticated CE system solutions to manage the resources	Discuss key issues in CE practices during movement control order and explore how BIM can fill the gaps
Rigillo *et al.* (2023)	International Journal of Architecture, Art and Design	2016–2022	62	Scopus	Circularity and digital technologies applicability in CDWM	Scoping Review	Explored the potential and limitations of digital technologies in circular CDWM	Focus solely on digital technologies
Centobelli *et al.* (2023)	Journal of Cleaner Production	1991–2020	4,027	Web of Science	Sustainable and circular construction	Bibliometric analysis	Provided a bird-eye-view of existing quantitative and qualitative research within seven identified themes	Focused only on a general overview
Santos *et al.* (2023)	Journal of Polymers and the Environment	Up to 2021	Not mentioned	Not mentioned	Construction, renovation, & demolition (CRD) of plastic waste treatment	State-of-art	Reviewed status quo, challenges, technologies, opportunities, barriers, and recent initiatives on recycling CRD plastic waste	Only capture CRD plastic waste

(*continued*)

Table 1.

Author(s)	Published journal	Period	Article considered	Database	Focus area	Applied methodology	Outcomes	Research gaps
Oluleye *et al.* (2022)	Journal of Cleaner Production	2014–2021	116	Scopus	CE research on building CDW	Bibliometric, Content Analysis	State-of-the-art on five research issues	More focus on CE-strategies for building CDW
Mhlanga *et al.* (2022)	Journal of Engineering, Design and Technology	2005–2021	31	Scopus	Shaping CE in the Built Environment in Africa	Bibliometric Analysis	Identified low CE research output in Africa	Focused only on African perspectives
Jahan *et al.* (2022)	Sustainability	2009–2020	49	Scopus, Web of Science, and Google Scholar	CE of construction and demolition wood waste	Bibliometric, Content Analysis	Identified waste management strategies involved in construction life cycle phases	Focused only on wood waste
Yang *et al.* (2022)	Journal of cleaner production	Up to 2022	1068 (Construction field) 873 (Manufacturing field)	Scopus and Web of Science	Attaining Circularity in construction	Scientometric review and cross-industry exploration	Circularity could be attained through the use of remanufactured and recycled non-CDW	This review outcomes are not specific to construction sector
Shooshtarian *et al.* (2022a, b, c)	Sustainable Production and Consumption	2000–2021	62	Google Scholar, Web of Science and Scopus	CE in the Australian CDW Management	Descriptive and Thematic analysis	Identified CDW disposal reduction opportunities and barriers in materials lifecycle	Focused only on Australian context
Aslam *et al.* (2020)	Journal of Environmental Management	Not mentioned	Not mentioned	Online platforms	CDWM in China and USA	Thematic Analysis	The USA has a more developed CDWM system than China due to some management deficiencies	Considered articles related to China and the USA only

(*continued*)

Author(s)	Published journal	Period	Article considered	Database	Focus area	Applied methodology	Outcomes	Research gaps
Jin *et al.* (2019)	Resources, Conservation, and Recycling	2009–2018	410	Scopus	Overview of CDWM research	Bibliometric Analysis	Provided the overall picture of CDWM-related research	General science mapping of articles
Present study	-	*Up to 2024*	*212*	*Scopus, Web of Science, EBSCO*	*State-of-the-art research on CE implementation in CDWM*	*Mixed-method (scientometric and critical analysis)*	*Uncovered the evolutionary progress, explored ten issues, and provided avenues for future research of CE in the CDWM fields*	

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Table 1.

provided comprehensive knowledge or strong research directions for future studies. To address these limitations and bridge previous research gaps, this study offers a state-of-the-art analysis of CE in CDWM using a mixed-method (scientometric and critical analysis) review strategy. The scientometric study is conducted from four perspectives: publication trends, mapping journal publications, mapping countries, and mapping keyword occurrences. On the other hand, a critical review is conducted based on ten themes including research characteristics, CDW monitoring, traceability and management tools, benefits and challenges of CE in CDWM, modeling approaches, modern technologies, decision support systems, enablers, barriers, performance measures, and existing models/frameworks.

Achieving the above objectives will assist researchers and academics in understanding the state-of-the-art and identifying hot research topics in CE implementation in the CDWM field. Furthermore, this study provides detailed guidelines and knowledge about future research areas, along with suggestions on how to address them. The findings will be invaluable to CE practitioners, managers, decision-makers, policymakers, construction and demolition planners, and other stakeholders, serving as a knowledge base to effectively manage CDWs. Additionally, the outcome may enable them to fund research efforts in identified salient fields.

The structure of this article is as follows: the methodology employed in this study is discussed in Section 2. Section 3 provides the results and discussion. Recommendations for researchers, practitioners, decision-makers, and policymakers are provided in Section 4. Section 5 discusses the future research areas by detailing key issues identified in the present study. Conclusion, followed by limitations, is provided in Section 6.

2. Methodology

The methodology employed in this study adopts an interpretive philosophical approach, drawing from previous publications (Ghosh *et al.*, 2021; Oluleye *et al.*, 2022). This approach elucidates the nuance and variabilities present in published literature, aiding researchers in conceptualizing novel research ideas. A mixed-method review process, comprising scientometric and critical analysis, was utilized. This method is also known as "explanatory design" approach. The integrated review approach fulfills the shortcomings of each other, as one can analyze the articles quantitatively while the other evaluates qualitatively. For example, the scientometric review approach helps investigate research developments and trends, describing the existing articles, their nature, sources, and information in quantitative form (Oluleye *et al.*, 2022). Whereas the critical review approach examines and evaluates article contents through in-depth analysis. Furthermore, it helps explore the evolution and advancement of research by identifying gaps qualitatively (Ghosh *et al.*, 2021). Moreover, the findings from the integrated approach have more strength than a single approach to illustrate the research gaps. Figure 1 outlines the research methodology process, the details of scientometric and critical analysis approach is separately discussed in subsections below.

2.1 Scientometric analysis

Scientometric analysis is employed to investigate research development and trends in quantitative form, offering comprehensive insights into authorship, country of origin, journal distribution, publishers, research fields, and citations (Oluleye *et al.*, 2022). It can also analyze various aspects of scientific publications, including collaboration networks, journal impact, and research topics, to gain insights into the development, structure, and dynamics of scientific knowledge, facilitating evidence-based decision-making (Oluleye *et al.*, 2022).

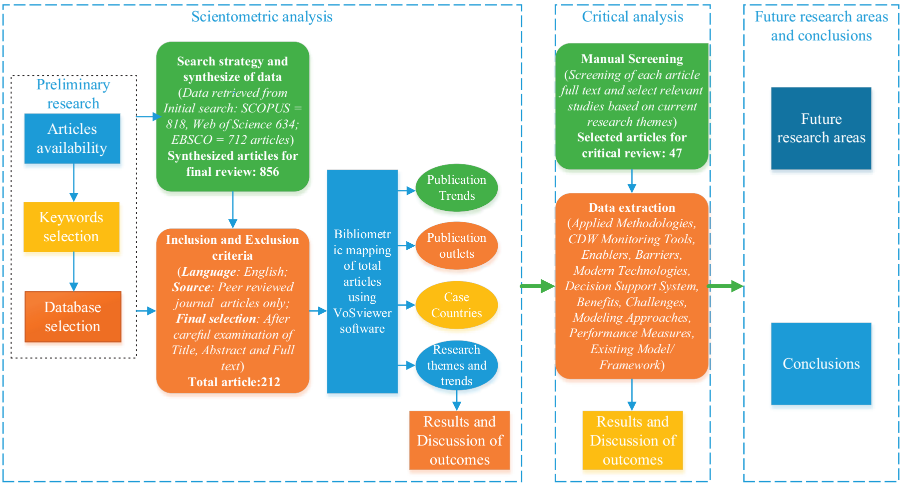

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Figure 1.
Research methodology

The analysis has utilized across various sectors, including construction and demolition, this analysis provides valuable insights into topics such as CE in construction (Illankoon and Vithanage, 2023), sustainability (Soyinka *et al.*, 2023), waste management (Sharma *et al.*, 2022), and barriers modeling (Oluleye *et al.*, 2022). The present study utilized VOSviewer software, Mendeley, and Excel spreadsheet to conduct the scientometric analysis. Further details regarding the findings are elaborated on in subsequent subsections.

2.1.1 Preliminary research. Initial research was conducted using popular open-source tools such as Google scholar to evaluate the availability, suitability, and usability of published articles for review purposes. The preliminary investigation revealed a scarcity of systematic reviews on the subject matter. None provided comprehensive insights into the CE in CDWM, particularly regarding CDW monitoring, traceability and management tools, enablers, barriers, modern technologies, decision support systems, benefits, challenges, modeling approaches, performance measures, and existing frameworks. The identified gaps informed the development of robust research questions.

2.1.2 Database selection, search strategy, and data synthesis. The selection of an appropriate database is the most critical part of conducting a literature review, as improper selection may result in missing relevant articles (Jahan *et al.*, 2022). Various databases are available, but the most popular once in the field of engineering and management are Scopus, Web of Science, and EBSCO (Illankoon and Vithanage, 2023; Soto-Paz *et al.*, 2023). Choosing these databases also minimizes the chances of overlooking any relevant article. Therefore, this study opted for these databases for article search and data extraction. A basic search was conducted in the selected databases using the search string “AND”, “OR”, and “AND/OR”, in titles, abstracts, and keywords. Subsequently, articles were synthesized to remove duplicity. Several rounds of refinement were employed to improve the article search outcome, utilizing keywords such as “Circularity”, “Circular economy”, “Circular business”, “Building project”, “Housing project”, “Construction and demolition”, and “Waste”. The initial search yielded 818 articles from Scopus, 634 from Web of Science, and 712 articles from EBSCO. The search was performed independently by two authors to reduce the chances of missing articles, and the outcomes were then validated to minimize bias in the findings.

2.1.3 Inclusion and exclusion criteria. The inclusion and exclusion criteria for the present study were aligned with Oluleye *et al.* (2023). The inclusion criteria encompassed articles focusing on the circular economy specifically within the construction sector, articles published in peer-reviewed journals, and no restrictions on publication year. Conversely, the exclusion criteria comprised articles focusing solely on the circular economy without considering construction and demolition waste management issues, articles published in sources other than peer-reviewed journals, articles in languages other than English, and the exclusion of book chapters, conference papers, and editorial notes. Additionally, duplicate articles were removed during the synthesis of articles from three selected databases. This process resulted in 212 articles exported to VosViewer software for bibliometric mapping.

2.1.4 Bibliometric mapping of articles. Bibliometric mapping is used for the in-depth mapping of existing articles and is typically performed using various software available in the marketplace such as VosViewer, CiteSpace, BibExcel, etc. VosViewer is the most popular and widely used software for text mining in the construction sector (Soto-Paz *et al.*, 2023). This software is extensively utilized for creating and visualizing massive networks. VOSviewer was adopted in this study for loading the dataset, data mining, keywords analysis, co-citation analysis, and analysis of countries and co-occurrences.

2.2 Critical analysis

A critical analysis of selected articles was performed using a theory-driven approach. Critical analysis entails conducting a comprehensive examination and evaluation of existing works, subjects, information, or ideas to understand their strengths, weaknesses, and implications (Jahan *et al.*, 2022). The goal is to explore research developments and qualitatively identify gaps. This process provides deep insights into various aspects such as facts, observations, evidence, strategies, tools, techniques, challenges, and arguments, enabling a judgment to be formed through skeptical, rational, and unbiased evaluation. The critical analysis goes beyond general description or simple summarization of the contents. It requires the ability to engage in analytical thinking, critically assess, analyze, and articulate insights. Over the years, critical analysis has been widely utilized to explore the evolution and advancement of research across different sectors, including construction. The detailed information presented in Figure 1 is briefly discussed in the following subsections.

2.2.1 Manual screening. The 212 shortlisted articles underwent manual screening to select relevant studies aligned with the current research themes. Each article was individually reviewed in full text by two authors to ensure relevance and minimize outcome biases. This manual screening process resulted in 47 articles being retained for further data extraction.

2.2.2 Data extraction. The study employed a theory-driven approach to extract data from the shortlisted articles. Data extraction was conducted on the selected 47 articles to analyze applied methodologies, CDW monitoring, traceability and management tools, enablers, barriers, modern technologies, decision support systems, benefits, challenges, modeling approaches, performance measures, and existing frameworks. Content analysis of these articles discussing the mentioned aspects was performed and is presented in Appendix.

3. Results and discussion

3.1 Bibliometric mapping outcomes

The outcomes of bibliometric mapping for the present study were performed from the following perspectives: (1) publication trends, (2) mapping journal publications, (3) mapping countries, and (4) mapping keywords occurrence.

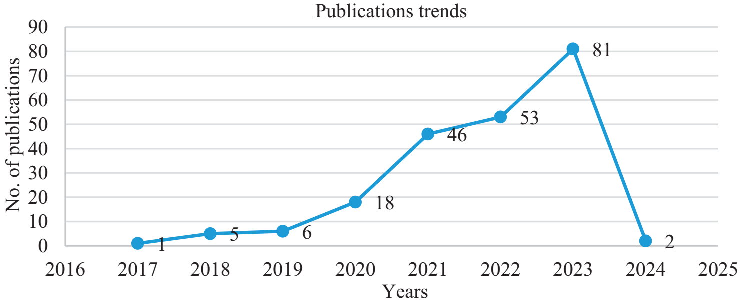

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Figure 2. Publication trends per year

3.1.1 Publication trends. The yearly publication trend of the shortlisted 212 articles related to CE in the CDWM field is presented in Figure 2. In this pool, the earliest study was conducted by Esa *et al.* (2017). The outcomes show that the real implication of CE in CDWM started in 2017 and has been explored since then. However, the application of CE in CDWM is still in its primary stage or new for many nations across the globe, which is slowly gaining interest, as evidenced by the continually increasing publications. The findings also imply a significant interest in CE research in CDWM in the last six years. Our findings align with previous publications, which state CE as one of the hottest approaches extensively applied in the construction sector (Véliz *et al.*, 2022; Luciano *et al.*, 2021). The start of the New Year (2024) with two publications in the first week itself shows increased interest levels and commitment towards annual publication trends. The shift from a linear approach to CE in the construction sector represents the social and governmental thinking toward the conservation of natural resources for the long term. It is also observed that CE is becoming imperative in the construction sector worldwide in managing CDW. The continuous increase in publications

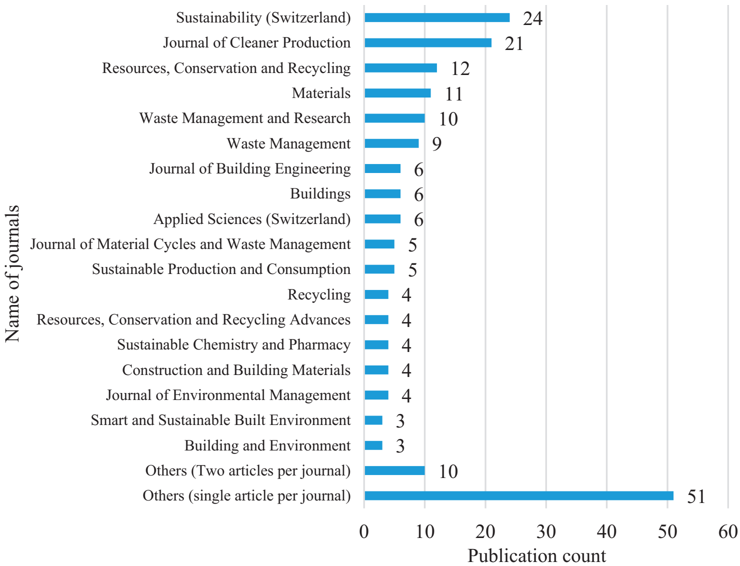

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Figure 3. Distribution of articles per journal

also signifies a global shift in the construction sector from a linear approach to a sustainable one, aimed at preventing natural resource depletion and promoting conservation.

3.1.2 Mapping journal publications. Figure 3 represents that the 212 articles are published in 79 different journals. The outcomes imply that 41% of articles are published in 6 journals, which include sustainability (Switzerland) (11%), Journal of Cleaner Production (10%), Resource, Conservation and Recycling (6%), Materials (5%), Waste Management and Research (5%), and Waste Management (4%). The larger publication rate in sustainability background journals also implies a greater linkage of CE in CDWM to a sustainable direction. Moreover, the adoption of CE to manage CDWM is growing interest globally and has a strong association with sustainable research backgrounds.

3.1.3 Mapping countries. The network collaboration of authors' countries helps in understanding the most productive countries in a specific research area. A clear understanding of the most productive countries is important in promoting research collaborations and funding (Ruiz *et al.*, 2020). This study used the following search criteria for mapping countries in VOSviewer software: type of analysis: co-authorship, unit of analysis: countries, maximum number of countries per document: 25. While the threshold was set as the minimum number of documents of a country: 3 and the minimum number of citations of a country: 5. Based on these criteria, of the 60 countries developing articles on CE in CDWM, only 26 meet the threshold presented in Table 2. However, the results imply that a total of 13% (26 out of 195) countries across the world are conducting research on CE in CDWM areas. Based on the findings, 13% is a relatively low percentage that conforms to our

Countries	Documents	Citations	Total link strength
China	24	1,940	19
United Kingdom	19	1,782	18
Spain	24	1,376	17
Italy	23	883	15
Australia	22	560	12
Hong Kong	14	992	11
United States	8	334	11
Canada	10	57	10
Chile	6	40	5
India	9	128	5
Malaysia	4	170	5
Turkey	7	54	5
Brazil	8	101	4
France	10	72	4
Iran	3	283	4
Netherland	9	330	4
Poland	6	65	4
Belgium	4	14	3
Portugal	9	268	3
Switzerland	6	84	3
Austria	7	210	2
Colombia	7	76	2
Denmark	3	25	2
Germany	9	480	2
Greece	3	43	1
Serbia	3	21	1

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Table 2.
Top Countries exploring research on CE in CDWM

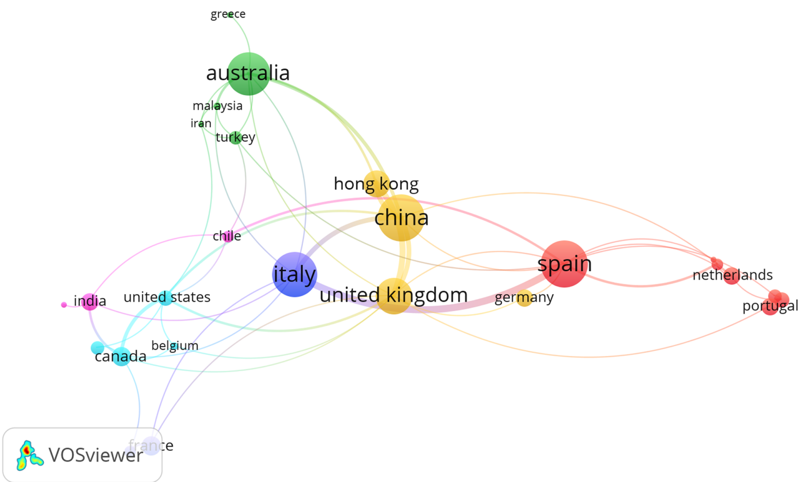

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Figure 4.
Most productive countries exploring research on CE in CDWM

previous findings related to the early stages of the CE concept in CDWM. The contribution of each country in terms of publications is presented by the size of the node in Figure 4.

Figure 4 shows that Spain and China have the largest node size than other contributors, indicating that these are the highest productive countries with 24 articles each. Italy, Australia, and the United Kingdom contributed with 23, 22, and 19 articles respectively. The most contributed countries in CE research in the domain of CDWM are Spain, China, Italy, Australia, and the United Kingdom. These countries might have implemented the CE concept in CDWM earlier than the other countries. Furthermore, the outcomes enlighten that developed countries are making more promising efforts than developing countries in promoting CE in CDWM fields. However, these efforts are still insufficient, as other countries such as Hong Kong, Germany, the Netherlands, Canada, Belgium, the United States, Austria, France, etc., are developed countries that have adopted CE in the effective management of CDW but have not conducted thorough research. This could be due to ineffective policy, lack of government support, or lack of experience in promoting CE for CDW management in the construction sector.

Moreover, Figure 4 represents six different clusters of countries based on how often they cite each other. For example, Australia, Greece, Iran, Malaysia, and Turkey belong to one cluster represented by the green color. The remaining countries are denoted in red, blue, yellow, pink, and purple color. Similarly, the network between countries and line thickness represents grater affinity; thus a strong link is represented by thicker lines.

3.1.4 Mapping keywords Co-occurrence. The key research areas of CE in CDWM were determined through mapping keyword co-occurrence. Utilizing the authors' keywords, six clusters were identified (Figure 5). The keyword network aids in representing knowledge about key research areas and understanding how they are mutually interconnected and organized (Wuni *et al.*, 2019). For keyword mapping, a minimum benchmark of three occurrences was set to ensure comprehensive cluster outcomes. During the process, some similar and redundant keywords were observed and combined using the thesaurus file. For instance, "Circular Economy (CE)", "CE", and "circular economy approach" were replaced by "circular economy". A few redundant keywords such as "China", and "bibliometric analysis" were removed to enhance outcome quality. After filtering results, 30 keywords remained, grouped into six different clusters. Figure 5 illustrates each cluster using different colors. The

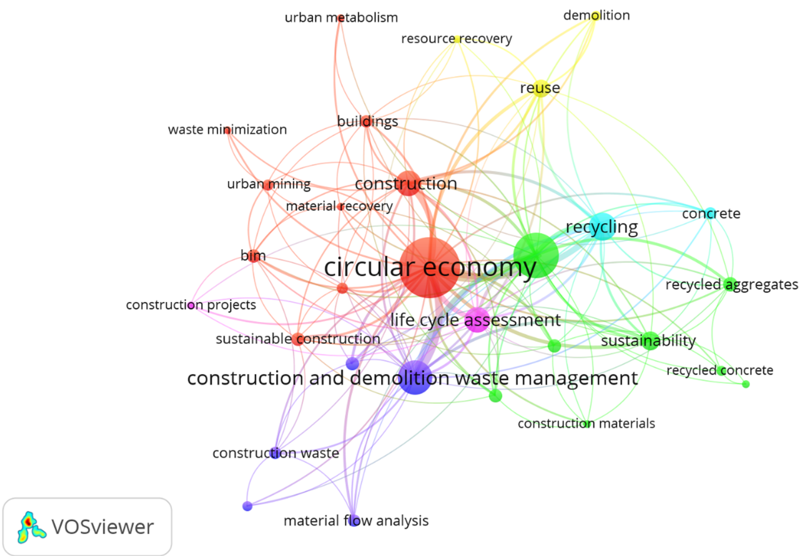

Figure 5.
Key research areas of CE in CDWM

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node size represents keyword co-occurrence, while line thickness indicates affinity. For example, the keyword "circular economy" exhibits the highest co-occurrence, and the thicker line between "circular economy" and "construction and demolition waste" represents a greater association between these two keywords. Each cluster, combined with key research areas, is discussed in detail below.

Cluster 1. This cluster includes keywords such as "BIM", "buildings", "circular economy", "construction", "material recovery", "resource efficiency", "sustainable construction", "urban metabolism", "urban mining", and "waste minimization" (Figure 5). The classification of these keywords under a single cluster signifies grater linkages among them. However, the results imply that the majority of authors focused their research on these themes. For instance, most studies related to CE in CDWM discussed BIM (Building Information Modeling), a structured process involving the systematic generation and management of building information using various software, digital tools, and technologies (Ismail, 2023; Mollaei *et al.*, 2023; Takyi-Annan and Zhang, 2023; Jayasinghe and Waldmann, 2020). Furthermore, BIM can contribute to improving material recovery and increasing resource efficiency in construction projects through material tracking and management, waste minimization, optimized design and planning, resource visualization, asset management, and recycling. Circular economy and construction and demolition waste management are the most prominent keywords in this cluster based on their node size, indicating a greater interest in these two research areas compared to others in this cluster. However, most studies focused on construction and demolition waste management strategies, policies, and challenges, while a structured roadmap to implement CE for effective management of CDW is still limited (Jahan *et al.*, 2022). Therefore, future studies should focus on developing theoretical and conceptual roadmaps for CE adoption in CDWM.

Cluster 2. This cluster includes keywords such as "construction and demolition waste", "construction material", "mechanical properties", "recycled aggregates", "recycled concrete", "sustainability", and "sustainable development". These keywords are related to construction and demolition waste materials, their circularity, properties, and sustainability. Extensive research on CE in CDWM has been conducted in these areas (Almokdad and Zentar, 2023; Li *et al.*, 2023; Tefa *et al.*, 2022; Morón *et al.*, 2021), demonstrating sustainable development in the construction sector. However, the use of recycled aggregates and concrete was more explained compared to other CDW materials such as steel, wood, glass, and plastic (Meglin *et al.*, 2022). Figure 5 illustrates that "construction and demolition waste" and "sustainability" have a bigger node size, indicating greater interest in these two topics than others classified in this cluster. Furthermore, there is minimum research on other CDW materials and their sustainability strategies, suggesting a need for future research in these areas. Moreover, there is limited research on trading platforms and customer buying interest in recycled, reused, and recovered materials through CDW.

Cluster 3. This cluster encompasses keywords such as "build environment", "construction and demolition waste management", "construction waste", "machine learning", and "material flow analyses". Previous studies have focused heavily on planning structured construction processes and proper management of CDW during the planning stage (Rybak-Niedziółka *et al.*, 2023; Cristiano *et al.*, 2021; Lachat *et al.*, 2021). However, the implementation of CE in the planning stage of construction effectively contributes to the systematic management of CDWs (Ismail, 2023). Furthermore, digital technologies such as machine learning and artificial intelligence contribute to predicting hazardous materials in buildings (Yu *et al.*, 2022). Additionally, the material flow analysis (MFA) approach has the potential for proper management of CDW materials. The MFA system helps understand the process function and its interrelation in CDW management (Abdelshafy and Walther, 2023). Although systematic linkages between MFA systems, resource optimization, waste minimization, and CDW management need further exploration.

Cluster 4. Substantial contributions have been made in the areas of CDWM, as evidenced in Figure 5, where key research themes such as "reuse", "demolition", and "resource recovery" are classified under a single cluster. Reuse is a major keyword in this cluster due to its larger node size than others, indicating its higher significance in CDWM. The high prominence of "reuse" in CDWM itself represents the need for CE in the effective management of CDW. Furthermore, the reuse concept contributes more to resource conservation and sustainable development. Although research exists related to resource recovery in CDWM areas, there is a lack of a structured approach or automated systems available for CDW recovery (van den Berg *et al.*, 2023). Moreover, limited research has been conducted on the challenges of material recovery and the adoption of used CDW materials. Additionally, research on the development of an efficient decision support system for effective CDW management and its association with resource recovery is scarce. The development of such an integrated system could be highly beneficial for optimizing resource recovery, minimizing CDWs, regulating compliance, assessing environmental impact, supporting decision-making, collaborating with stakeholders, and bringing continuous improvement in CDWM.

Cluster 5. This cluster encompasses only two keywords: "construction project" and "life cycle assessment". The research contribution in this cluster focuses on the life cycle assessment of construction projects. The life cycle assessment of construction projects is one of the most effective ways to assess the impact of construction materials, methods, approaches, components, and products on the environment (Tefa *et al.*, 2022). However, the systematic analysis of materials' life cycle in construction projects contributes to minimizing landfill wastes, ultimately aiding in resource conservation and sustainability (Ivanica *et al.*, 2022). Life cycle assessment has a larger node size in this cluster, demonstrating its higher contribution to literature in CDWM areas. Although studies focus on the life cycle assessment of construction materials, the limited contribution is noticed on life cycle assessment indicators and a structured assessment approach in the CDWM field.

Cluster 6. This cluster consists of two key research themes: "concrete" and "recycling" (Figure 5). This cluster illustrates the circularity approach of concrete material, mainly produced from construction and demolition projects. The recycling approach helps promote sustainability and conserve natural resources for the future (Czekała *et al.*, 2023). Several CE strategies exist in the literature such as Refuse, Rethink, Reduce, Reuse, Repair, Remanufacturing, Refurbish, Repurpose, Recycling, and Recover, but Recycling is extensively adopted in the CDW field (Ramos *et al.*, 2023a, b). Several CDWs that cannot be used directly could be recycled (Oluleye *et al.*, 2023). Although the recycling strategy is applied to various CDW materials, there is still research needed to develop a structured decision support system that can be integrated with CE strategies.

3.2 Critical review outcomes

The outcomes of the critical review for the present study are based on the following themes: (1) Research characteristics, (2) CDW monitoring, traceability, and management tools, (3) Benefits and challenges of CE in CDWM, (4) Modeling approaches for CDWM, (5) Modern technologies for CDWM, (6) Decision support system developed for CDWM, (7) Enablers discussed in previous publications, (8) Barriers reported in previous articles, (9) Performance measures covering CDWM, and (10) Existing CE-based CDWM models/frameworks.

3.2.1 Research characteristics. Over the past few years, research in the CE domain, specifically in the CDW management field, has been conducted, utilizing various research types to increase understanding and promote the shift from linear to CE. These research types include deductive research, qualitative, quantitative, mixed-method study, case study, descriptive, and theoretical research (Table 3). A summary reveals that case study, quantitative, qualitative, and mixed-method research have been extensively utilized by researchers than other approaches, indicating these research types are more appropriate for emerging/developing research fields. However, survey and interview methods have gained momentum in recent years, representing their strength in capturing individual perceptions, knowledge, and experience for making critical decisions. Additionally, these methods help increase researchers' knowledge through the utilization of modern tools, techniques, or software such as NVivo, Microsoft Teams, LinkedIn, Zoom, SPSS, Google Meet, SPSS, Qualtrics, Excel, R, Python, Google forms, and Survey Monkey. Although some statistical approaches are gaining attention, modeling approaches and survival analysis to solve CDWM problems in CE are scarce. Moreover, few studies applied machine learning for CDW management; the application of artificial intelligence in this field could bring impactful benefits in managing CDWs. Therefore, attention should be given to AI research in the future to promote digitalization in the CE transition in the CDWM field. It has also been observed that the application of IoT and blockchain has been extensively applied in the construction sector, but there is a lack of practical applicability, especially in the management of CDW. Therefore, the adoption of these innovative technologies into CDWM could bring extensive sustainable benefits. For example, the adoption of IoT devices such as mobile applications and sensors can capture information about CDW. Robotics can recover CDW within a minimum time period. Meanwhile, the adoption of blockchain applications secures CDW data with transparency (Bao and Lu, 2020).

3.2.2 CDW monitoring, traceability and management tools. Tools are an essential part of optimizing any process, reducing time, effort, and resources, ensuring accuracy, and improving quality. The right tool can efficiently complete tasks within the designated time frame, facilitating project completion by the due date (Guo *et al.*, 2022). Time is a crucial constraint in CDW management, and tools can help minimize it, enhancing overall efficiency and reducing CDW management costs (Shooshtarian *et al.*, 2022a, b, c). The summary of tools used in CDW management is presented in Table 4. The findings reveal that there are very

Research type	Method	Software/Tools/ Technique	Statistical test/ Analysis approach	Reference
Deductive research	Hypothesis development		Wilcoxon signed-rank test, Shapiro-Wilk test	Ramos *et al.* (2023a, b)
Qualitative	Semi-structured interviews	NVivo, Microsoft Teams, LinkedIn, Zoom, SPSS, Google Meet	Delphi technique, Fuzzy analytic hierarchy process (FAHP), Thematic analysis, Balanced scorecard approach	Boateng *et al.* (2023), Ramos *et al.* (2023a), Boonkanit and Suthiluck (2023), Villoria Sáez *et al.* (2023), Shooshtarian *et al.* (2022a, b, c), Torgautov *et al.* (2022), Sobotka and Sagan (2021), Huang *et al.* (2018)
Quantitative	Survey	Timed Petri net, Google Forms, Survey Monkey, Qualtrics, Excel, R software, SPSS	Barrier mapping, MICMAC analysis, Exploratory factor analysis (EFA), Rank agreement analysis (RAA), Fuzzy synthetic evaluation (FSE), Contingent valuation method, fuzzy TOPSIS	Ma *et al.* (2023), Véliz *et al.* (2023), Oluleye *et al.* (2023), Shooshtarian *et al.* (2022a), Véliz *et al.* (2022), Wu *et al.* (2022b), Guo *et al.* (2022), Salleh *et al.* (2022), Mahpour (2018)
Mixed Method study (Qualitative and Quantitative)	Interview and Survey	SPSS, Qualtrics, Excel, NVivo, Google Forms, Microsoft Teams, Zoom, Google Meet	ANOVA, SWOT analysis, Relative Importance Index (RII), Factor Analysis, Regression analysis	Ma *et al.* (2023), Kabirifar *et al.* (2023), Meng *et al.* (2023), Cheng *et al.* (2023), Luciano *et al.* (2022), Liu *et al.* (2021), Esguícero *et al.* (2021), Condotta and Zatta (2021), Noll *et al.* (2019), Ghaffar *et al.* (2020), Bao and Lu (2020)
Case study	On-site visits and data collection	3D printer, i-Tree Canopy	Resource mapping, Environmental screening, Deep convolutional neural networks, Mathematic modeling, Optimization modeling, SWOT analysis	Saeed *et al.* (2023), Christensen *et al.* (2022), Rigillo *et al.* (2022), Lin *et al.* (2022), Mercader-Moyano *et al.* (2022), Tsydenova *et al.* (2021), Cristiano *et al.* (2021), Lachat *et al.* (2021), Davis *et al.* (2021), Oliveira *et al.* (2021), Mihai (2019)
Descriptive Research	Data collected from online repositories	Machine learning		Wu *et al.* (2022a), Jayasinghe and Waldmann (2020)
Theoretical Research	Analysis of scientific and practical information		Mathematical modeling	Shuvaiev *et al.* (2022)

Source(s): Table created by authors

Table 3. Summary of research characteristics

few tools existing in previous research; therefore, there is a need to develop more advanced tools for CDW management.

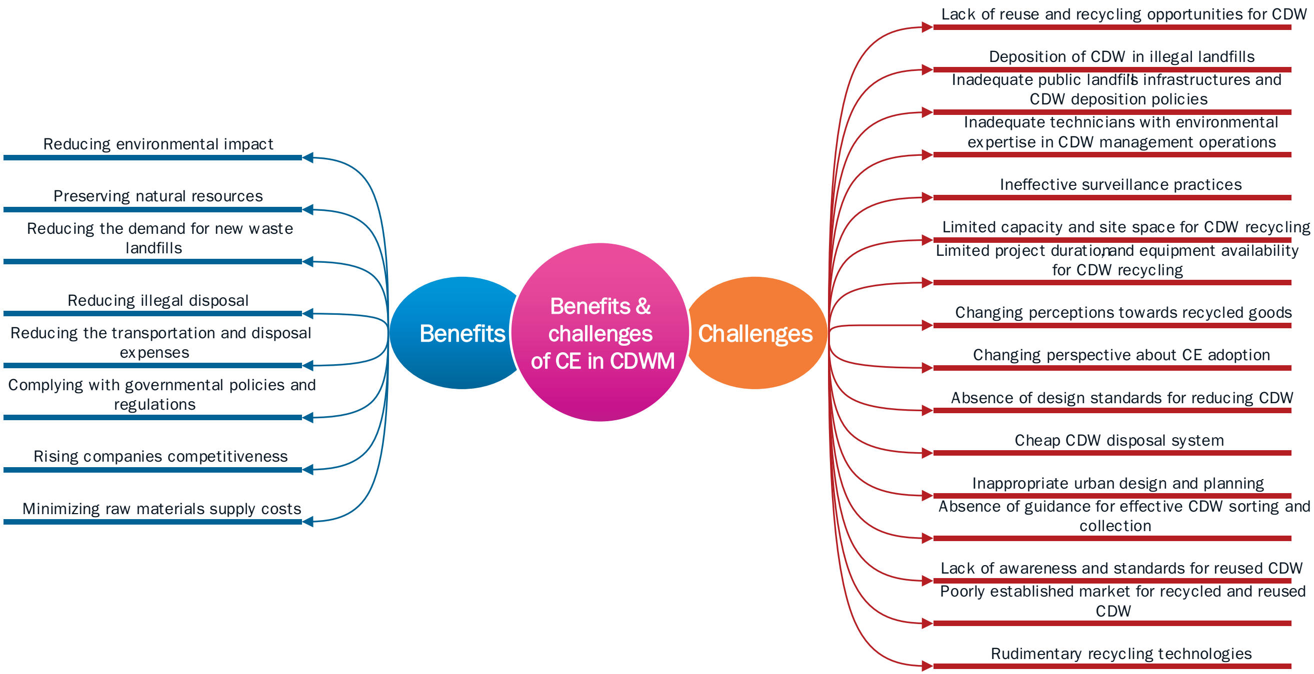
Table 4. Summary of CDW monitoring and management tools

Tool	Objective	Entities/User	Ability	Reference
CORDOVA Mobile Application	Helps estimate, trace, and manage the amount of CDW generated, ensuring proper waste management	Construction managers, CDW truck drivers, Recycling plant managers	Estimate the total amount, type, total distance traveled, and total cost of CDW, and generate the report	Villoria Sáez *et al.* (2023)
i-Tree Canopy software	Identifies the total available buildings in the area, and estimates materials	Evaluators	Obtains buildings-related data	Cristiano *et al.* (2021)
Mobile app	Traceability and Management of CDW	Construction companies, Citizens, CDW disposal companies	Commercialize, donate, exchange, advertise	Oliveira *et al.* (2021)
DECORUM platform	Helps manage CDW efficiently with transparency	Public tender, Design, and construction company, CDW managers	Facilitates green public procurement	Luciano *et al.* (2021)
Building Information Modelling (BIM)	Stores material information, building components, and promotes the recycling and reuse of components	Projects and Materials managers	Extracts materials and component information	Jayasinghe and Waldmann (2020)

Source(s): Table created by authors

3.2.3 Benefits and challenges of CE in CDWM. The terms "benefits" and "challenges" are interconnected, as understanding the benefits can motivate overcoming challenges. However, challenges arise alongside benefits, associated with adopting circular practices in effective CDWM. Understanding and addressing these interconnected terms are crucial for successfully integrating CE principles into effective CDW management in the construction sector (Huang *et al.*, 2018; Luciano *et al.*, 2022; Al Zulayq *et al.*, 2022). Facing challenges is essential for both personal and organizational growth because it pushes us out of our comfort zones, encourages the development of new skills, and fosters resilience (Huang *et al.*, 2018). Furthermore, challenges identified in the adoption of CE practices in organizations can serve as opportunities for continuous improvement (Bao and Lu, 2020). Effectively addressing CE challenges in CDW management can enhance organizational performance, leading to higher benefits (Oliveira *et al.*, 2021). Figure 6 depicts the common challenges and benefits existing in the literature.

3.2.4 Modeling approaches for CDWM. Modeling approaches play a vital role in CDWM by providing structured models to guide, understand, analyze, and optimize the processes involved. They aid in decision-making across various aspects such as scenario analysis, life cycle assessment, resource optimization, technology integration, policy development, and continuous improvement (Ma *et al.*, 2022; Kabirifar *et al.*, 2023). Modeling enables quantitative analysis of factors like total quantity, type, and nature of wastes generated in construction and demolition projects (Sobotka and Sagan, 2021), as well as assists in resource optimization including materials, manpower, equipment, and circular facilities (Kabirifar *et al.*, 2023). Additionally, modeling facilities assess life cycle assessment approaches, considering the environmental impact of construction and demolition (C&D) materials and



Source(s): Figure created by authors

Figure 6. Benefits and challenges of CE in CDWM

Modeling method	Objective	Reference
Integrated Fuzzy Delphi Technique and Analytic Hierarchy Process	To adopt the CE in CDW management	Kabirifar *et al.* (2023)
Timed Petri Nets	To develop a trading platform for CD wastes	Wu *et al.* (2022b)
Replication Dynamic System Four-Party Game	To develop a system for sustainable CDW recycling	Guo *et al.* (2022)
Kolmogorov's Differentiated Equations	To develop a model for forecasting the total CDW amount	Shuvaiev *et al.* (2022)
Integrated System Dynamics and LCA Approach	To develop an integrated model for evaluating the carbon emissions of CDW	Ma *et al.* (2022)
Multi-criteria Analysis Module	To identify the most favorable solution for managing CDW	Sobotka and Sagan (2021)
Dynamic Stock-Driven Modelling	To assess the CDW material flows associated with the construction sector	Noll *et al.* (2019)

Source(s): Table created by authors

Table 5.
Modeling approaches for CDWM

circular processes from extraction to disposal (Ma *et al.*, 2022). Various applications and advantages of modeling approaches in the field of CE in CDWM have been observed, and a few approaches discussed in existing articles are summarized in Table 5.

3.2.5 Modern technologies for CDWM. Technologies play an important role in the C&D field by introducing innovative solutions to manage CDW, resulting in improved efficiency, enhanced resource recovery, and maintained material circularity. Modern technologies aid in better planning, monitoring, tracing, sorting, and optimizing C&D wastes, leading to enhanced resource consumption and sustainability (Wu *et al.*, 2022a). The existing modern technologies in the reviewed articles in the context of CDWM are presented in Table 6.

3.2.6 Decision support system developed for CDWM. A decision support system (DSS) is a comprehensive tool that assists stakeholders in various aspects of CDWM, playing a crucial role in facilitating effective decision-making in this field and leading to improved planning and management of C&D wastes (Sobotka and Sagan, 2021). The integration of DSS in CDWM can enhance decision-making processes by optimizing resources, managing data, ensuring compliance, analyzing scenarios, tracking information, generating reports, and promoting collaborations among stakeholders (Saeed *et al.*, 2023). However, the absence of DSS in the CDWM process results in a less streamlined process, leading to inefficient operational efficiency of organizational processes (Tsydenova *et al.*, 2021). This leads to resource wastage, data integrity, and security risks, reduced environmental impact, and

Technology	Objective	Reference
Digital Twin	To deal efficiently with real-time and dynamic information concerning CDWM	Meng *et al.* (2023)
3D Printing	To construct buildings using recycled aggregates and produce cement mortars suitable for 3D printing technology	Rigillo *et al.* (2022)
Deep Convolutional Neural Networks	To classify and automate CDW separation	Lin *et al.* (2022), Davis *et al.* (2021)
Machine Learning	To predict potential hazardous CDW inventories	Wu *et al.* (2022a)
GPS-Based Vehicle System	To systematically transport CDW	Bao and Lu (2020)

Source(s): Table created by authors

Table 6.
Modern technologies for CDWM

Decision support system	Objective	Reference
Multi-objective model	Optimizes decision-making for managing CDW generated during construction project demolition	Saeed *et al.* (2023)
Decision-Making Support System	Helps in selecting the appropriate concrete waste management approach using Fuzzy AHP	Boonkanit and Suthiluck (2023)
Bi-objective mixed integer linear optimization model	Provides information about the location of installed sorting screens and material flows from building demolition to the construction of new buildings	Tsydenova *et al.* (2021)
Spider web method	Supports the decision-making process of technology selection solutions for concrete waste management	Sobotka and Sagan (2021)

Source(s): Table created by authors

Table 7. Decision support system for CDWM

impact on stakeholders and overall strategic objectives. Therefore, efforts are needed to develop the right DSS to mitigate these losses. Table 7 presents the DSS proposed in previous studies.

3.2.7 Enablers discussed in previous publications. Enablers of CE play a vital role in optimizing CDW management, enhancing resource efficiency, and promoting circular materials. These enablers drive the implementation of modern technologies in CDW management, facilitating innovative processes such as smart waste tracking, collection, sorting, and recycling techniques (Noll *et al.*, 2019). Addressing these enablers effectively is crucial for the successful adoption of CE practices in CDW management, as failure to do so can lead to unsustainable losses (Mahpour, 2018; Yu *et al.*, 2022). Therefore, organizational managers must consider these enablers and address them effectively before initiating CE adoption. The CE enablers related to CDW management, identified in reviewed articles, are provided in Table 8, which includes enablers across various dimensions such as cultural, environmental, organizational, technical, regulatory, and economic.

3.2.8 Barriers reported in previous articles. Barriers serve as obstacles that hinder the successful adoption of CE practices in managing CDW (Liu *et al.*, 2021). However, the consideration of CE enablers in the construction industry helps managers in the effective management of CDWM, whereas ignoring barriers could lead to failures (Shooshtarian *et al.*, 2022a, b, c). Therefore, proper consideration of CE barriers is also mandatory, along with considering enablers, to increase the chances of successful implementation of CE in organizations for the effective management of CDW. The barriers proposed in reviewed articles are presented in Table 9.

3.2.9 Performance measures covering CDWM. Performance measures are essential parameters for assessing the effectiveness and efficiency of programs, projects, or initiatives. These measures are used as primary inputs in the performance measurement process to evaluate the performance of any project, individual, group, system, component, or organization (Ratnasabapathy *et al.*, 2021). However, performance measures are crucial for evaluating circular strategies and enhancing sustainability in the construction sector (Nie *et al.*, 2024). Furthermore, these measures evaluate the efficiency and effectiveness of CDWM practices in minimizing environmental impacts and achieving the company's circular goals. The performance measures used in previous studies are depicted in Figure 7. The financial perspective encompasses strategies and plans aimed at increasing revenue and managing a business's financial risk. An organization achieves these goals by meeting the needs of customers, shareholders, and suppliers. The customers' and stakeholders' perspective refers to evaluating a company's performance from the viewpoint of its customers and stakeholders. This assessment involves understanding their needs, expectations, and satisfaction levels regarding the products, services, and overall performance of the

Dimensions	Enablers	Author(s)
Cultural	Increase awareness of CE adoption benefits in CDW management	Gherman *et al.* (2023), Oluleye *et al.* (2023)
	Provide training/organize workshops to teach CE adoption for CDWM	Gherman *et al.* (2023), Oluleye *et al.* (2023)
	Promote the green image of organizations	Gherman *et al.* (2023)
Environmental	Site waste management	Noll *et al.* (2019), Kabirifar *et al.* (2023), Ma *et al.* (2023)
	On-site sorting, recycling, and reusing of wasted material	Bao and Lu (2020), Kabirifar *et al.* (2023), Oluleye *et al.* (2023)
	Waste avoidance	Kabirifar *et al.* (2023)
	Use of durable materials	Ma *et al.* (2023)
	Minimize the use of virgin materials	Gherman *et al.* (2023)
Organizational	Adoption of advanced processing and sourcing technologies	Charef *et al.* (2021), Ma *et al.* (2022, 2023)
	Adoption of advanced CDWM technics	Charef *et al.* (2021), Yu *et al.* (2022)
	Demolition audits to increase CDW recyclability/reusability	Luciano *et al.* (2022), Kabirifar *et al.* (2023)
	Collaboration between CDWM stakeholders	Gherman *et al.* (2023)
	Integrate CE principles in the design phase	Gherman *et al.* (2023)
	Management commitment and support	Gherman *et al.* (2023)
	Availability of space for storage	Gherman *et al.* (2023)
	Adoption of low waste generation technologies	Kabirifar *et al.* (2023)
	Adoption of less wastes demolition techniques	Kabirifar *et al.* (2023)
Technical	Circular design	Esa *et al.* (2017), Mahpour (2018), Gálvez-Martos *et al.* (2018)
	Development of circular/green procurement system	Liu *et al.* (2021), Gherman *et al.* (2023)
	Development of digital markets for secondary materials	Gherman *et al.*, (2023), Shooshtarian *et al.* (2022a, b, c), Ma *et al.* (2023), Oluleye *et al.* (2023)
	Develop tools and guidelines for CDW collection and separation	Gherman *et al.* (2023), Oluleye *et al.* (2023)
	Development and adoption of circular business model and decision support system for CDW management	Oluleye *et al.* (2023), Gherman *et al.* (2023)
	Develop CE metrics and indicators for CDWM	Oluleye *et al.* (2023)
	Establish structured guidelines and roadmap for implementation of CE in CDWM	Oluleye *et al.* (2023)
	Develop advanced CDW recycling logistics (e.g., Adverse logistics, GIS)	Pani *et al.* (2020), Yu *et al.* (2022)
	Develop advanced demolition approaches (e. g. Deconstruction)	Ghaffar *et al.* (2020), Ginga *et al.* (2020)
	Development and adoption of the advanced information technologies (e.g., BIM)	Charef *et al.* (2021), Ma *et al.* (2022), Gherman *et al.* (2023)
	Continuous research on CE-based research in CDW management	Oluleye *et al.* (2023)

(*continued*)

Table 8.
Existing enablers in articles

Dimensions	Enablers	Author(s)
Regulatory economic	Standards for secondary materials	Ma *et al.* (2023)
	Global agreement on regulations	Gherman *et al.* (2023)
	Clear national plans on CE goals in CDWM and policy support	Gherman *et al.* (2023), Oluleye *et al.* (2023)
	Improve secondary material value and quality	Sharma *et al.* (2022), Ma *et al.* (2023)
	Incentives for waste recovery	Ma *et al.* (2023)
	Incentives for utilizing Circular/Secondary materials	Ma *et al.* (2023), Gherman *et al.* (2023), Oluleye *et al.* (2023)
	Increase costs of landfilling/penalties for illegal damping	Gherman *et al.* (2023), Oluleye *et al.* (2023)
	Funding for circular projects	Gherman *et al.* (2023)
	Budget allocation for CE adoption in CDWM by the government	Oluleye *et al.* (2023)

Source(s): Table created by authors

Table 8.

organization. The Internal Process perspective measures an organization's ability to meet customer needs and expectations through internal processes, products, and services. It encompasses various aspects such as manufacturing, marketing, sales processes, as well as customer service and support services. The learning and growth perspective examines the company's vitality in terms of training employees on rapidly changing technologies and enhancing their productivity.

3.2.10 Existing CE-based CDWM models/frameworks. A model or framework plays an important role in stepwise guiding stakeholders to attain project goals or objectives. The CE-based framework, integrated with various components including circular strategies, practices, tools, techniques, indicators, measures, support systems, and innovative technologies, helps in promoting sustainable practices in CDWM in the construction sector and conserving natural resources. The CE-based structured framework can assist managers and other associated employees in the effective management of CDW, resulting in enhanced resource efficiency, sustainability, reduced waste, environmental foot prints, improved financial benefits, stakeholder engagement, and compliance with regulations (Huang *et al.*, 2018). The successful adoption of the CE framework in the construction industry can enhance circularity by effectively managing CDW and efficiently optimizing resources. Therefore, the adoption of a structured and clear roadmap is essential to integrate CE in CDWM in the construction sector. A few CE-based models/frameworks related to CDWM proposed in existing articles are presented in Table 10.

4. Recommendations for researchers, practitioners, decision-makers, and policymakers

The study findings provide stepwise recommendations for researchers, practitioners, decision-makers, and policymakers on how CE principles can be integrated into CDWM practices in the construction sector:

Researchers can conduct comprehensive case studies to analyze the adoption of CE principles in the real environment of CDWM projects by referring to previous studies' knowledge. They can explore innovative technologies discussed in this study for the reuse, recycling, and upcycling of CDW materials. Furthermore, life cycle assessment can be performed to investigate the economic viability and environmental impact of the current project. Additionally, investigating and comparing the enablers, barriers, and challenges discussed in the present study through collaborating with industry stakeholders. Finally,

Dimension	Barriers	Author(s)
Environmental	Lack of storage space/site	Charef *et al.* (2021), Alite *et al.* (2023), Mhatre *et al.* (2023)
	CDW transportation emissions for the 3R process	Charef *et al.* (2021)
	Limitations of site access for CDWM	Charef *et al.* (2021), Shooshtarian *et al.* (2022a, b, c)
	Health and safety risks from contaminated materials	Charef *et al.* (2021), Shooshtarian *et al.* (2022a, b, c), Mhatre *et al.* (2023)
	Short-term/Rapid Urban growth plan	Véliz *et al.* (2023)
	Availability of cheaper virgin products/materials	Shooshtarian *et al.* (2022a, b, c), Mhatre *et al.* (2023)
Economic	Minimum landfilling cost	Charef *et al.* (2021), Luciano *et al.* (2022), Shooshtarian *et al.* (2022a, b, c)
	Underdeveloped market for secondary/recycled materials	Charef *et al.* (2021), Shooshtarian *et al.* (2022a, b, c), Mhatre *et al.* (2023)
	Profit-driven decision-making	Charef *et al.* (2021), Shooshtarian *et al.* (2022a, b, c)
	High costs of secondary/circular materials	Charef *et al.* (2021), Véliz *et al.* (2023), Christensen *et al.* (2022), HaitherAli and Anjali (2023), Luciano *et al.* (2022), Shooshtarian *et al.* (2022a, b, c), Mhatre *et al.* (2023), Liu *et al.* (2021), Mahpour (2018)
	High upfront investment costs for CDWM	Charef *et al.* (2021), Véliz *et al.* (2023), HaitherAli and Anjali (2023), Mhatre *et al.* (2023)
	Lack of investment in infrastructure and equipment	Ramos *et al.* (2023a), HaitherAli and Anjali (2023), Mhatre *et al.* (2023)
	Availability of limited funding for circular projects	Charef *et al.* (2021), Shooshtarian *et al.* (2022a, b, c), Mahpour (2018)
	Private recycling and processing	Alite *et al.* (2023), Ramos *et al.* (2023a), Mahpour (2018)
	Absence of Incentives for circular CDWM	Véliz *et al.* (2023), Shooshtarian *et al.* (2022a, b, c), Liu *et al.* (2021)
Cultural	Limited strategic vision and stakeholders' collaboration	Charef *et al.* (2021), Véliz *et al.* (2023), Mahpour (2018)
	Lack of awareness about the CDWM benefits	Charef *et al.* (2021), Christensen *et al.* (2022), Liu *et al.* (2021), Mahpour (2018)
	Resistance to adopting secondary/circular materials by stakeholders	Charef *et al.* (2021), Shooshtarian *et al.* (2022a, b, c), Mhatre *et al.* (2023), Mahpour (2018)
	Lack of information available on the quality of recycled materials	Charef *et al.* (2021), Luciano *et al.* (2022)
	Lack of awareness and treatment centers for CDWM	Alite *et al.* (2023), Charef *et al.* (2021)

Table 9.
Existing barriers in articles

(*continued*)

Dimension	Barriers	Author(s)
Organizational	Depends on the linear system	Charef *et al.* (2021), Mhatre *et al.* (2023), Mahpour (2018)
	Poor supply chain and partnership	Charef *et al.* (2021), Mhatre *et al.* (2023)
	Lack of information, skills, training and experience	Charef *et al.* (2021), Christensen *et al.* (2022), Liu *et al.* (2021)
	Lack of time and human resources	Charef *et al.* (2021), Ramos *et al.* (2023a), Shooshtarian *et al.* (2022a, b, c), Mhatre *et al.* (2023), Mahpour (2018)
	Absence of top management commitment and support for circularity	Charef *et al.* (2021), Mahpour (2018)
	Lack of proper enforcement, supervision, and control	HaitherAli and Anjali (2023), Luciano *et al.* (2022), Shooshtarian *et al.* (2022a, b, c), Mahpour (2018)
	Lack of communication, co-ordination, and collaboration among stakeholders	HaitherAli and Anjali (2023), Liu *et al.* (2021)
	Lack of demand for C&D waste recycling and reuse	Luciano *et al.* (2022), Shooshtarian *et al.* (2022a, b, c), Mhatre *et al.* (2023)
	Lack of balance between supply and demand of circular materials/products in the market	Luciano *et al.* (2022), Shooshtarian *et al.* (2022a, b, c), Mhatre *et al.* (2023)
Technical	High investment costs for new CDWM technology adoption	Charef *et al.* (2021), Luciano *et al.* (2022), Shooshtarian *et al.* (2022a, b, c), Liu *et al.* (2021), Mahpour (2018)
	Absence of an information exchange system related to data on CDW generation, material flow/characteristics, cost involved, etc	Charef *et al.* (2021), HaitherAli and Anjali (2023), Luciano *et al.* (2022), Shooshtarian *et al.* (2022a, b, c), Mahpour (2018)
	Lack of tools/techniques for material sorting and recovery	Charef *et al.* (2021), Shooshtarian *et al.* (2022a, b, c)
	Absence of circular design procedure/ guidelines	Charef *et al.* (2021)
	Poor record keeping	Alite *et al.* (2023), Mahpour (2018)
	Absence of proper CDW management solutions	Ramos *et al.* (2023a), Liu *et al.* (2021), Mahpour (2018)
	Lack of structured roadmap or framework to manage CDW	Alite *et al.* (2023), Ramos and Martinho (2021), Christensen *et al.* (2022), Liu *et al.* (2021), Mahpour (2018)
	Lack of Infrastructure and poor knowledge of material treatment/CDWM advanced technologies	Véliz *et al.* (2023), HaitherAli and Anjali (2023), Shooshtarian *et al.* (2022a, b, c), Mhatre *et al.* (2023), Liu *et al.* (2021)
	Absence of certified recycled materials	Véliz *et al.* (2023), Christensen *et al.* (2022)
	Lack of local market for circular/secondary materials	Shooshtarian *et al.* (2022a, b, c), HaitherAli and Anjali (2023), Mhatre *et al.* (2023)
	Availability of poor-quality recycled materials/products	HaitherAli and Anjali (2023), Shooshtarian *et al.* (2022a, b, c), Luciano *et al.* (2022), Mhatre *et al.* (2023), Liu *et al.* (2021)
	Lack of Reverse logistics and circular business models	HaitherAli and Anjali (2023), Mahpour (2018)
	Lack of effective technology for CDW data tracing	HaitherAli and Anjali (2023), Mahpour (2018)
	Lack of a stable supplier for C&DW transport	Véliz *et al.* (2022)

(*continued*)

Table 9.

Dimension	Barriers	Author(s)
Regulatory	Lack of circular procurement	Charef *et al.* (2021), Mhatre *et al.* (2023)
	Absence of global consensus about CE	Charef *et al.* (2021), Luciano *et al.* (2022)
	Absence of standardization	Charef *et al.* (2021), Christensen *et al.* (2022), HaitherAli and Anjali (2023), Mahpour (2018)
	Absence of structured procedures and guidelines to comply with legal orientations	Ramos *et al.* (2023a), Shooshtarian *et al.* (2022a, b, c)
	Lack of regulations/policy and unclear responsibilities	HaitherAli and Anjali (2023), Luciano *et al.* (2022), Mhatre *et al.* (2023), Liu *et al.* (2021)
	Lack of environmental management system and certifications	Véliz *et al.* (2022)
	Lack of potential actions against CDW management	Véliz *et al.* (2022), Luciano *et al.* (2022), Shooshtarian *et al.* (2022a, b, c), Liu *et al.* (2021)

Table 9.

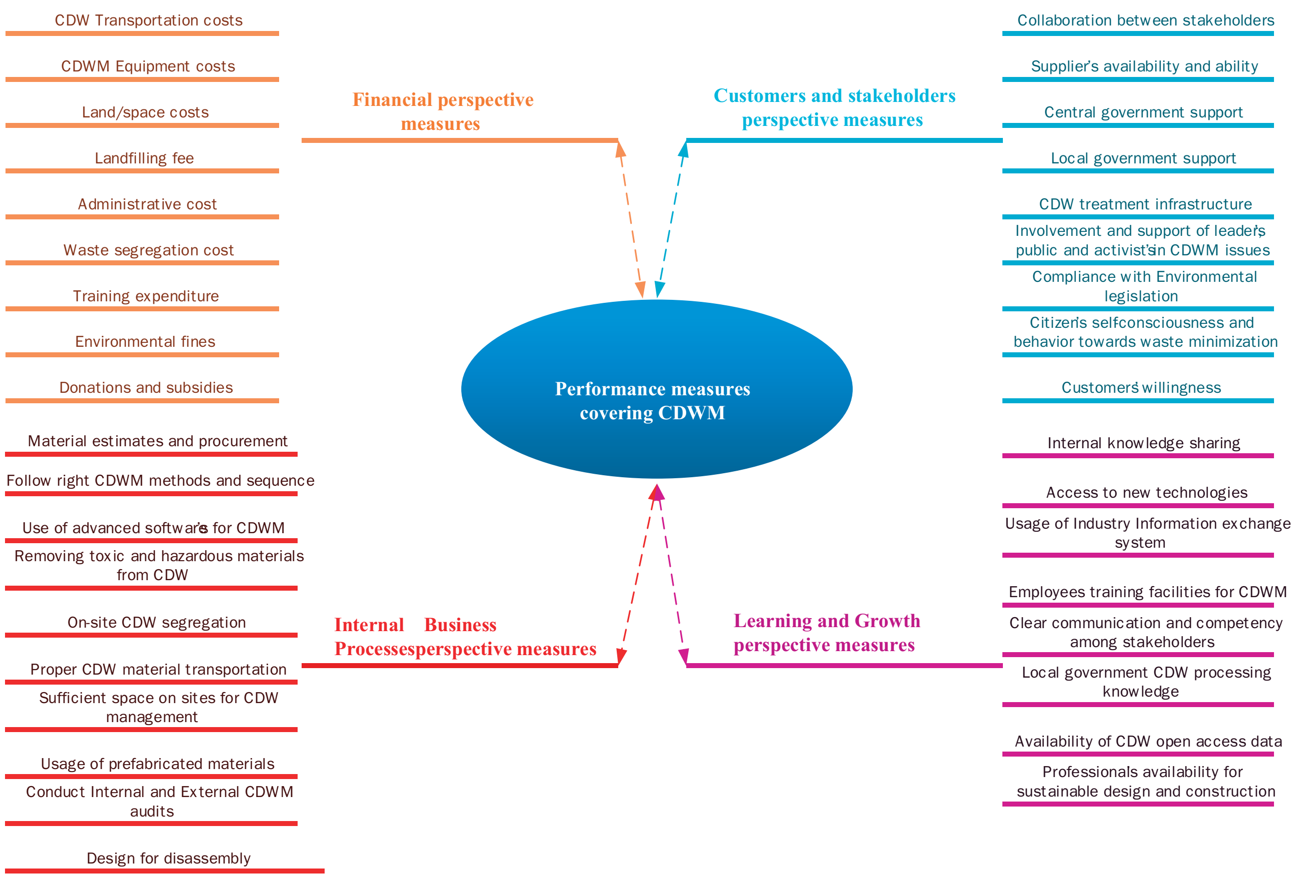
Source(s): Table created by authors

developing a strategy on how to adopt enablers, handle barriers, and overcome challenges. A structured framework can also be developed to simplify the process of CE adoption in the construction sector to effectively manage CDW.

Practitioners can implement CDW sorting and segregating systems to recover materials for reuse and recycling on construction sites. Hence, the incorporation of design for deconstruction and disassembly principles during the building design process could be an effective approach to maximize material recovery. The adoption of recycling facilities by establishing partnerships with waste management organizations could ensure smooth handling of CDW materials and reduce the social and environmental impact. Collaboration with waste management firms could also save time, effort, and resources in terms of the economy, improving quality, increasing construction speed, and enhancing the circular construction process. Additionally, educating construction managers, supervisors, and workers on the benefits, challenges, enablers, barriers, tools, performance measures, and modern technologies of CE principles and providing structured training on effective CDW reduction and recycling techniques.

Furthermore, the findings can guide decision-makers to develop rules and regulations such as waste diversion targets, incentives for sustainable construction projects, appraisals for resource reduction, increments for zero waste, and fast recovery, etc., towards implementing CE principles in CDWM practices. Funding and resource allocation within an organization for research and development initiatives could enhance the development of advanced CE methodologies and technologies for CDW management. Decision-makers can also collaborate with industry and academic stakeholders to establish benchmarks and standard practices for circular CDW management. Promoting public-private partnerships could enhance the collection, sorting, and processing of CDW materials in the construction sector. The implementation of CDW monitoring and traceability tools could also help to effectively manage CDW.

This study recommends policymakers to integrate CE principles into local and national CDW management strategies, targeting maximum material recovery and minimum landfill disposal. Policymakers should incorporate tax rebates and incentive schemes to adopt CE principles in the construction process. The identified barriers and challenges in this study towards implementing policies for circular construction can be overcome by collaborating between industry stakeholders, government agencies, and research institutions, leading to more sustainable and resource-efficient outcomes in the built environment.



Source(s): Figure created by authors

Figure 7. Performance measures covering CDWM

CDWM phase I	Phase II	Phase III	Phase IV	Phase V	Reference
Preparation-(Planning, permitting, and licensing of CDWM operators)	Generation-(Activities leading to the generation of CDW)	Collection and Transport	Processing	Temporary Storage	Alite *et al.* (2023)
Onsite CDW separation	Recycling of CDW considering government regulations	Auditor certification of recycled product	Sale in the end market		Shooshtarian *et al.* (2022a, b, c)
Set target	Establish infrastructure	Enact rules and regulations	Enforce and implement	Monitor, Control, Analyze, and feedback Research & Improve	HaitherAli and Anjali (2023)
Characterization and selection of sample	CDW quantification	CDW environmental indicators	Material resource circularity		Mercader-Moyano *et al.* (2022)
Generation (CDW generation through traditional/ selective approach)	Source separation (concrete, recyclable, non-recyclable, or other materials)	Collection and transport	Waste treatment (Stationary/ Mobile recycling, landfill, biological plant)	Substitutions (Plastic, Insulating, Wood, Natural aggregates, etc.)	Iodice *et al.* (2021)
CDW collection from sites and Transportation	Cursing and Grinding of CDW	Separation through Flotation, Magnetic, Washing, etc	Production and Storage	Transport for use and landfill	Lachat *et al.* (2021)
CDW collection	Transportation	Recycling plant	Marketplace	Use in construction	Luciano *et al.* (2021)
Waste generation	Collection and Transport	Inspection	Recycling/ Reuse/Final disposal		Esguícero *et al.* (2021)
Waste identification	Source separation and collection	Waste logistics	Waste processing	Use in construction	Condotta and Zatta (2021)
Open dumping of CDW	Collection and disposal in Urban Landfills	Treatment and Reuse in Civil Construction	Integrated waste management system	Building materials	Mihai (2019)
On-site CDW classification	Reclassification	Crush	Particle size classification	Material market/ Backfill material/ Landfills/ Roadbed filter	Huang *et al.* (2018)

Source(s): Table created by authors

Table 10.
Summary of existing CE-Based CDWM frameworks

Themes	Key findings	How knowledge could be improved
Research characteristics	The majority of the studies rely on surveys, interviews, case studies, and mixed-method strategy methodology	Integration of interview, survey, and case study methodologies could compare findings and enhance the soundness of outcomes
CDW monitoring, Traceability, and Management tools	Only a few tools have been developed and introduced in the literature	Thorough contextual-based empirical studies are needed to understand actual needs and challenges in CDWM to rethink the development of new tools
Benefits and Challenges of CE in CDWM	Case-based benefits and challenges are discussed	Comparative studies could help understand contextual economic-based challenges and provide solutions. A system could be developed to prioritize solutions based on associated challenges
Modeling Approaches for CDWM	Few modeling approaches are used to solve issues related to CE in CDWM	Other modeling approaches such as optimization modeling, system dynamics modeling, agent-based modeling, network modeling, and conceptual modeling could be explored to solve CDWM-related issues
Modern Technologies for CDWM	Limited application of modern technologies is observed	Effective integration of Industry 4.0 technologies such as additive manufacturing, artificial intelligence, cloud computing, blockchain, digital twins, Industrial Internet of Things, Machine learning, and autonomous robots could enhance the effective adoption of CE in CDWM areas
Decision Support System Developed for CDWM	Existing decision support systems can decide on separate issues	The development of a single knowledge-based decision support system for CDWM could enhance CE adoption in the construction sector
Enablers & Barriers Discussed in Publications	Enablers and barriers have been identified manually and listed	Developing a structured model could improve the successful implementation of CE in CDWM fields
Performance Measures Covering CDWM	No metric system exists in the literature for performance measures	The creation of a proper metric system could improve the assessment of CE performance in CDWM effectively
Existing CE-Based CDWM Models/ Frameworks	Existing models or frameworks still rely on a linear economy foundation	Developing the framework by integrating indicators, measures, barriers, enablers, decision support systems, tools, techniques, standards, challenges, modern technologies, and knowledge management systems could improve the implementation success of CE practices in CDWM

Source(s): Table created by authors

Table 11. Summary of key issues from reviewed articles

5. Future research areas

The outcomes of this review reveal that the adoption of CE in the CDWM field is still in its initial stages. While studies have explored a few issues, there is a need for more in-depth exploration and research (refer to Table 11) to fully harness the potential of CE integration in CDWM. The future research directions are discussed pointwise in subsections to assist in implementing CE in CDWM within the construction sector.

5.1 Adoption of CE strategies in the CDWM field

Research on CE strategies specific to the CDWM field is limited, with the majority of existing studies focused on 3R (Reuse, Reduce, and Recycle). However, a thoughtful and systematic approach to selecting CE strategies for managing CDW is lacking. Furthermore, the implementation of CE practices and strategies cannot occur in isolation without considering its measures, contextual issues, and the dynamism of factors surrounding it (Oluleye *et al.*, 2022). There is a scarcity of empirical research on measures for integrating CE strategies with CDW categories, the dynamism of factors affecting CE strategies, and contextual parameters for adopting CE based on economies. Moreover, less research has been undertaken on appropriate selection approaches of CE strategies in managing CDW. Investigating these issues through conducting empirical studies using mixed-method approaches (interviews, surveys, and site visits) would enhance CE implementation in the construction sector for CDWM.

5.2 Model for CE adoption enablers and barriers in CDWM

While studies on the barriers and enablers of CE in CDWM are prevalent in literature, a structured model for systematically considering these factors for effective CE adoption in the CDWM field is still scarce. Enhancing, the understanding of these enablers and barriers can improve their effective consideration within organizations, ultimately, leading to successful CE implementation in CDWM. Furthermore, such a structured model assists managers in identifying the leading factors, and optimizing the use of limited resources, time, and efforts, thus resulting in financial savings. Researchers can use multi-criteria decision-making (MCDM) tools to develop the structured model for CE adoption of enablers and barriers.

5.3 Development of CE readiness assessment tool in CDWM

Research on readiness assessment tools (RAT) for CE adoption in the CDWM field is limited. RATs are essential for evaluating the readiness level of CE adoption in CDWM and assessing the maturity level of CE adoption in waste management. Additionally, these tools aid in identifying factors crucial for the effective implementation of CE in CDWM. Therefore, future research focusing on readiness factors and the development of RATs for CE in CDWM is warranted. The identification and utilization of readiness factors for CDWM could help develop the RAT in the construction sector.

5.4 Integration of life cycle assessment indicators for CE in CDWM

While studies on the circular lifecycle of CDWs exist, the proper integration of LCA indicators with CDWM practices is still scarce. Integrating LCA indicators with CDWM practices would enable stakeholders to prioritize resource efficiency, circularity, and environmental sustainability when making decisions. Hence, empirical research on various LCA indicators at different phases of CDWM is necessary.

5.5 Development of a CE performance measurement system in CDWM

Research on performance measurement systems (PMS) for assessing CE adoption performance in managing and optimizing CDWs is limited. The need for a PMS is imperative as it will facilitate the evaluation of CE initiatives' effectiveness in CDWM. A PMS could be designed to evaluate the efficiency of resource utilization, energy consumption, and emissions, material recovery and recycling, stakeholder involvement, waste minimization, and procurement in CE. The existence of a PMS would motivate construction and demolition practitioners, managers, and other stakeholders to make circularity decisions. Therefore, the development of a PMS for CE in CDWM is needed in the near future. The PMS can be developed by setting standards through collaboration among industry stakeholders, government agencies, and research institutions.

5.6 Contextual challenges of CE in CDWM and their solutions

CE challenges are prominent in the literature; few of them provide specific solutions based on their present problem. However, the contextual challenges for CE adoption, based on the economics of both developing and developed regions, and their specific solutions, are still scarce. A system could be developed to prioritize solutions based on associated challenges. Investigating this issue and developing a structured system would enhance the adoption of CE in the CDWM field. Empirical studies using survey methodology could help gather relevant information about the challenges of CE in CDWM from experts. Additionally, case studies involving interviews with practitioners, decision-makers, and planners could help identify potential solutions.

5.7 Roadmap for CE adoption in CDWM

Existing models/frameworks in the CDWM field still stand on the linear economy foundation. However, there are no systematic guidelines or structured paths to follow systematically toward achieving the successful adoption of CE in the CDWM sector (Govindan and Hasanagic, 2018; Oluleye *et al.*, 2022). Further, the existing frameworks lack integration of measures, indicators, barriers, enablers, decision support systems, tools, techniques, standards, challenges, modern technologies, and knowledge management systems that support increasing the implementation success of CE practices in CDWM. The majority of existing models adopt cradle-to-cradle strategies as a replacement for the traditional linear model. These models mostly fail to achieve successful adoption of CE in CDWM due to several challenges such as inadequate standardization, absence of design standards for circularity, inadequate technologies, low financial incentives, lack of balance between supply and demand, and life cycle costs. Therefore, future studies should develop a new roadmap or improve existing frameworks towards effective adoption of CE in CDWM. The actual implementation of existing frameworks across multiple CDWM sites could offer insights into their applicability, challenges, and shortcomings, thereby guiding the modification or development of new frameworks.

5.8 Application of innovative and modern technologies for CE adoption in CDWM

In the fourth industrial revolution, the integration of Industry 4.0 (I4.0) technologies such as additive manufacturing, artificial intelligence, could computing, blockchain, digital twins, Industrial Internet of Things, machine learning, and autonomous robotic systems in CE for the management of CDW is still limited (Bao and Lu, 2020; Wu *et al.*, 2022a). However, I4.0 technologies have emerged as key players in shifting from linear to circular economy practices in the manufacturing sector (Norouzi *et al.*, 2021). The effective integration of I4.0 technologies in CE could efficiently manage CDW and promote sustainable development goals (SDGs). The compatibility of I4.0 technologies with CE practices facilitates optimizing resource utilization in the industrial system (Norouzi *et al.*, 2021). Future studies are needed to explore these integrations through empirical studies to achieve circularity in CDWM.

5.9 Build an effective knowledge management system

Knowledge can drive innovative changes in any organization, and these changes can be realized through proper creation, sharing, and management of knowledge across the organization. However, the utilization of knowledge management in the area of CE in CDWM is limited. The construction sector in many developing and developed countries is even unaware of adopting CE practices in the CDWM field, and their understanding of how to promote CE for managing CDWs remains insufficiently illuminated (Mahpour, 2018; Oluleye *et al.*, 2022). A knowledge management system facilitates creating awareness and improving in-depth understanding of concerned areas (Mahpour, 2018). Therefore, more research is needed to investigate the building process of an effective knowledge management system and its systematic integration with CE processes, especially in the CDWM field.

6. Conclusions

The CE serves as a production and consumption model, greatly impacting the management of CDWs. To discern trends and research issues in CDW management within the context of CE, a mixed-method review strategy was employed. This approach proved beneficial in mitigating the ambiguities inherent in solely qualitative or quantitative review techniques. Analyzing existing articles on CE in CDWM revealed prevalent research trends and highlighted ongoing debates, thus identifying knowledge gaps for future studies. The review delineates key research themes, explores ten issues, and knowledge gaps, and outlines directions for future research endeavors. Previous studies in the field extensively utilized surveys, interviews, case studies, or mixed-method approaches as methodologies, with a notable focus on CDW monitoring and traceability tools to enhance CE adoption rates in the construction sector. The outcomes of the present study have shed light on key issues and provided several suggestions for future research aimed at promoting sustainable construction. The successful incorporation of the suggested recommendations into the construction sector would help achieve zero waste goals, facilitate natural resource conservation, and reduce carbon emissions. This, in turn, would support society and improve the quality of life for people.

This research offers significant insights into CDW management by synthesizing previous studies, bolstering the practicality and efficacy of the CE in the construction and demolition industries. The findings pave the way for future research in the realm of CDW management within the CE paradigm, delineating avenues for researchers and academics to explore innovative approaches and expand knowledge in this field. Practitioners stand to benefit from understanding the challenges, enablers, barriers, tools, and modern technologies associated with CE adoption in CDWM. Construction and demolition managers can utilize identified performance measures to evaluate CE performance in CDWM, while policymakers can address associated challenges and barriers to inform policy adjustments or new developments. Additionally, construction and demolition planners can leverage existing frameworks to enhance their understanding and develop compatible frameworks for CDWM based on contemporary requirements and challenges.

Despite these significant contributions, this research has limitations. It focused solely on peer-reviewed articles published in journals, potentially influencing the coverage of publications on the topic. The use of specific keywords for article searches may introduce bias, with alternative keywords possibly yielding more relevant papers. Future investigations should consider these limitations for comprehensive exploration.

References

Abdelshafy, A. and Walther, G. (2023), “Using dynamic-locational material flow analysis to model the development of urban stock”, *Building Research and Information*, Vol. 51 No. 1, pp. 5-20, doi: 10.1080/09613218.2022.2142495.

Al Zulayq, D.M., O’Brien, B.T., Kowalewski, M.J., Berenjian, A., Tarighaleslami, A.H. and Seifan, M. (2022), “Circular economy of construction and demolition waste: a literature review on lessons, challenges, and benefits”, *Materials*, Vol. 15, p. 76, doi: 10.3390/ma15010076.

Alite, M., Abu-Omar, H., Agurcia, M.T., Jácome, M., Kenney, J., Tapia, A. and Siebel, M. (2023), "Construction and demolition waste management in Kosovo: a survey of challenges and opportunities on the road to circular economy", *Journal of Material Cycles and Waste Management*, Vol. 25 No. 2, pp. 1191-1203, doi: 10.1007/s10163-022-01577-5.

Almokdad, M. and Zentar, R. (2023), "Characterization of recycled dredged Sediments: toward circular economy in road construction", *Construction and Building Materials*, Vol. 402, 132974, doi: 10.1016/j.conbuildmat.2023.132974.

Aslam, M.S., Huang, B. and Cui, L. (2020), "Review of construction and demolition waste management in China and USA", *Journal of Environmental Management*, Vol. 264, 110445, doi: 10.1016/j.jenvman.2020.110445.

Bao, Z. and Lu, W. (2020), "Developing efficient circularity for construction and demolition waste management in fast emerging economies: lessons learned from Shenzhen, China", *Science of the Total Environment*, Vol. 724, 138264, doi: 10.1016/j.scitotenv.2020.138264.

Bilal, M., Khan, K.I.A., Thaheem, M.J. and Nasir, A.R. (2020), "Current state and barriers to the circular economy in the building sector: towards a mitigation framework", *Journal of Cleaner Production*, Vol. 276, 123250, doi: 10.1016/j.jclepro.2020.123250.

Boateng, S.B., Banawi, A.A., Asa, E., Yu, Y. and Ahiable, C. (2023), "Environmental and economic outlook of construction and demolition waste management practices in a mid-sized city", *Journal of Material Cycles and Waste Management*, Vol. 25 No. 4, pp. 1-17, doi: 10.1007/s10163-023-01667-y.

Boonkanit, P. and Suthiluck, K. (2023), "Developing a decision-making support system for a smart construction and demolition waste transition to a circular economy", *Sustainability*, Vol. 15 No. 12, p. 9672, doi: 10.3390/su15129672.

Bressanelli, G., Pigosso, D.C., Saccani, N. and Perona, M. (2021), "Enablers, levers and benefits of Circular Economy in the Electrical and Electronic Equipment supply chain: a literature review", *Journal of Cleaner Production*, Vol. 298, 126819, doi: 10.1016/j.jclepro.2021.126819.

Centobelli, P., Cerchione, R., Ertz, M. and Oropallo, E. (2023), "What we learn is what we earn from sustainable and circular construction", *Journal of Cleaner Production*, Vol. 382, 135183, doi: 10.1016/j.jclepro.2022.135183.

Charef, R., Morel, J.C. and Rakhshan, K. (2021), "Barriers to implementing the circular economy in the construction industry: a critical review", *Sustainability*, Vol. 13 No. 23, 12989, doi: 10.3390/su132312989.

Cheng, B., Huang, J., Guo, Z., Li, J. and Chen, H. (2023), "Towards sustainable construction through better construction and demolition waste management practices: a SWOT analysis of Suzhou, China", *International Journal of Construction Management*, Vol. 23 No. 15, pp. 2614-2624, doi: 10.1080/15623599.2022.2081406.

Christensen, T.B., Johansen, M.R., Buchard, M.V. and Glarborg, C.N. (2022), "Closing the material loops for construction and demolition waste: the circular economy on the island Bornholm, Denmark", *Resources, Conservation and Recycling Advances*, Vol. 15, 200104, doi: 10.1016/j.rcradv.2022.200104.

Condotta, M. and Zatta, E. (2021), "Reuse of building elements in the architectural practice and the European regulatory context: inconsistencies and possible improvements", *Journal of Cleaner Production*, Vol. 318, 128413, doi: 10.1016/j.jclepro.2021.128413.

Cristiano, S., Ghisellini, P., D'Ambrosio, G., Xue, J., Nesticò, A., Gonella, F. and Ulgiati, S. (2021), "Construction and demolition waste in the Metropolitan City of Naples, Italy: state of the art, circular design, and sustainable planning opportunities", *Journal of Cleaner Production*, Vol. 293, 125856, doi: 10.1016/j.jclepro.2021.125856.

Czekała, W., Drozdowski, J. and Łabiak, P. (2023), "Modern technologies for waste management: a review", *Applied Sciences*, Vol. 13 No. 15, p. 8847, doi: 10.3390/app13158847.

Davis, P., Aziz, F., Newaz, M.T., Sher, W. and Simon, L. (2021), "The classification of construction waste material using a deep convolutional neural network", *Automation in Construction*, Vol. 122, 103481, doi: 10.1016/j.autcon.2020.103481.

Ellen MacArthur Foundation (2015), *Delivering the Circular Economy: A Toolkit for Policymakers*, Ellen MacArthur Foundation, Cowes.

Esa, M.R., Halog, A. and Rigamonti, L. (2017), "Developing strategies for managing construction and demolition wastes in Malaysia based on the concept of circular economy", *Journal of Material Cycles and Waste Management*, Vol. 19 No. 3, pp. 1144-1154, doi: 10.1007/s10163-016-0516-x.

Esguícero, F.J., Deus, R.M., Battistelle, R., Martins, B.L. and Bezerra, B.S. (2021), "Construction and demolition waste management process modeling: a framework for the Brazilian context", *Journal of Material Cycles and Waste Management*, Vol. 23 No. 5, pp. 2037-2050, doi: 10.1007/s10163-021-01247-y.

Gálvez-Martos, J.L., Styles, D., Schoenberger, H. and Zeschmar-Lahl, B. (2018), "Construction and demolition waste best management practice in Europe", *Resources, Conservation and Recycling*, Vol. 136, pp. 166-178, doi: 10.1016/j.resconrec.2018.04.016.

García-Sánchez, I.M., Somohano-Rodríguez, F.M., Amor-Esteban, V. and Frías-Aceituno, J.V. (2021), "Which region and which sector leads the circular economy? CEBIX, a multivariant index based on business actions", *Journal of Environmental Management*, Vol. 297, 113299, doi: 10.1016/j.jenvman.2021.113299.

Ghaffar, S.H., Burman, M. and Braimah, N. (2020), "Pathways to circular construction: an integrated management of construction and demolition waste for resource recovery", *Journal of Cleaner Production*, Vol. 244, 118710, doi: 10.1016/j.jclepro.2019.118710.

Gherman, I.E., Lakatos, E.S., Clinci, S.D., Lungu, F., Constandoiu, V.V., Cioca, L.I. and Rada, E.C. (2023), "Circularity outlines in the construction and demolition waste management: a literature review", *Recycling*, Vol. 8 No. 5, p. 69, doi: 10.3390/recycling8050069.

Ghosh, A., Edwards, D.J. and Hosseini, M.R. (2021), "Patterns and trends in Internet of Things (IoT) research: future applications in the construction industry", *Engineering, Construction and Architectural Management*, Vol. 28 No. 2, pp. 457-481, doi: 10.1108/ecam-04-2020-0271.

Ginga, C.P., Ongpeng, J.M.C. and Daly, M.K.M. (2020), "Circular economy on construction and demolition waste: a literature review on material recovery and production", *Materials*, Vol. 13 No. 13, p. 2970, doi: 10.3390/ma13132970.

Govindan, K. and Hasanagic, M. (2018), "A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective", *International Journal of Production Research*, Vol. 56 Nos 1-2, pp. 278-311, doi: 10.1080/00207543.2017.1402141.

Guo, F., Wang, J. and Song, Y. (2022), "How to promote sustainable development of construction and demolition waste recycling systems: production subsidies or consumption subsidies?", *Sustainable Production and Consumption*, Vol. 32, pp. 407-423, doi: 10.1016/j.spc.2022.05.002.

HaitherAli, H. and Anjali, G. (2023), "Circular economy in construction sector—a guideline for policy makers from global perspective", *Circular Economy and Sustainability*, pp. 1-29, doi: 10.1007/s43615-023-00321-x.

Huang, B., Wang, X., Kua, H., Geng, Y., Bleischwitz, R. and Ren, J. (2018), "Construction and demolition waste management in China through the 3R principle", *Resources, Conservation and Recycling*, Vol. 129, pp. 36-44, doi: 10.1016/j.resconrec.2017.09.029.

Illankoon, C. and Vithanage, S.C. (2023), "Closing the loop in the construction industry: a systematic literature review on the development of circular economy", *Journal of Building Engineering*, Vol. 76, 107362, doi: 10.1016/j.jobe.2023.107362.

Iodice, S., Garbarino, E., Cerreta, M. and Tonini, D. (2021), "Sustainability assessment of Construction and Demolition Waste management applied to an Italian case", *Waste Management*, Vol. 128, pp. 83-98, doi: 10.1016/j.wasman.2021.04.031.

Ismail, Z.A.B. (2023), "A critical study of the existing issues in circular economy practices during movement control order: can BIM fill the gap?", *Engineering, Construction and Architectural Management*, Vol. 30 No. 8, pp. 3224-3241, doi: 10.1108/ecam-08-2021-0676.

Ivanica, R., Risse, M., Weber-Blaschke, G. and Richter, K. (2022), "Development of a life cycle inventory database and life cycle impact assessment of the building demolition stage: a case study in Germany", *Journal of Cleaner Production*, Vol. 338, 130631, doi: 10.1016/j.jclepro.2022.130631.

Jahan, I., Zhang, G., Bhuiyan, M. and Navaratnam, S. (2022), "Circular economy of construction and demolition wood waste—a theoretical framework approach", *Sustainability*, Vol. 14 No. 17, 10478, doi: 10.3390/su141710478.

Jayasinghe, L.B. and Waldmann, D. (2020), "Development of a BIM-based web tool as a material and component bank for a sustainable construction industry", *Sustainability*, Vol. 12 No. 5, p. 1766, doi: 10.3390/su12051766.

Jin, R., Yuan, H. and Chen, Q. (2019), "Science mapping approach to assisting the review of construction and demolition waste management research published between 2009 and 2018", *Resources, Conservation and Recycling*, Vol. 140, pp. 175-188, doi: 10.1016/j.resconrec.2018.09.029.

Kabirifar, K., Ashour, M., Yazdani, M., Mahdiyar, A. and Malekjafarian, M. (2023), "Cybernetic-parsimonious MCDM modeling with application to the adoption of Circular Economy in waste management", *Applied Soft Computing*, Vol. 139, 110186, doi: 10.1016/j.asoc.2023.110186.

Lachat, A., Mantalovas, K., Desbois, T., Yazoghli-Marzouk, O., Colas, A.S., Di Mino, G. and Feraille, A. (2021), "From buildings' end of life to aggregate recycling under a circular economic perspective: a comparative life cycle assessment case study", *Sustainability*, Vol. 13 No. 17, p. 9625, doi: 10.3390/su13179625.

Li, J., Zhao, X., Yong, Q., Liang, J. and Wu, H. (2023), "Revealing the implicit and explicit attitudes of the public towards recycled aggregate based on psychological experiment", *Developments in the Built Environment*, Vol. 16, 100280, doi: 10.1016/j.dibe.2023.100280.

Lin, K., Zhou, T., Gao, X., Li, Z., Duan, H., Wu, H., Lu, G. and Zhao, Y. (2022), "Deep convolutional neural networks for construction and demolition waste classification: VGGNet structures, cyclical learning rate, and knowledge transfer", *Journal of Environmental Management*, Vol. 318, 115501, doi: 10.1016/j.jenvman.2022.115501.

Liu, J., Wu, P., Jiang, Y. and Wang, X. (2021), "Explore potential barriers of applying circular economy in construction and demolition waste recycling", *Journal of Cleaner Production*, Vol. 326, 129400, doi: 10.1016/j.jclepro.2021.129400.

Luciano, A., Cutaia, L., Cioffi, F. and Sinibaldi, C. (2021), "Demolition and construction recycling unified management: the DECORUM platform for improvement of resource efficiency in the construction sector", *Environmental Science and Pollution Research*, Vol. 28 No. 19, pp. 24558-24569, doi: 10.1007/s11356-020-09513-6.

Luciano, A., Cutaia, L., Altamura, P. and Penalvo, E. (2022), "Critical issues hindering a widespread construction and demolition waste (CDW) recycling practice in EU countries and actions to undertake: the stakeholder's perspective", *Sustainable Chemistry and Pharmacy*, Vol. 29, 100745, doi: 10.1016/j.scp.2022.100745.

Ma, W., Hao, J.L., Zhang, C., Guo, F. and Di Sarno, L. (2022), "System dynamics-life cycle assessment causal loop model for evaluating the carbon emissions of building refurbishment construction and demolition waste", *Waste and Biomass Valorization*, Vol. 13 No. 9, pp. 4099-4113, doi: 10.1007/s12649-022-01796-9.

Ma, W., Liu, T., Hao, J.L., Wu, W. and Gu, X. (2023), "Towards a circular economy for construction and demolition waste management in China: critical success factors", *Sustainable Chemistry and Pharmacy*, Vol. 35, 101226, doi: 10.1016/j.scp.2023.101226.

Mahpour, A. (2018), "Prioritizing barriers to adopt circular economy in construction and demolition waste management", *Resources, Conservation and Recycling*, Vol. 134, pp. 216-227, doi: 10.1016/j.resconrec.2018.01.026.

Meglin, R., Kytzia, S. and Habert, G. (2022), "Regional environmental-economic assessment of building materials to promote circular economy: comparison of three Swiss cantons", *Resources, Conservation and Recycling*, Vol. 181, 106247, doi: 10.1016/j.resconrec.2022.106247.

Meng, X., Das, S. and Meng, J. (2023), "Integration of digital twin and circular economy in the construction industry", *Sustainability*, Vol. 15 No. 17, 13186, doi: 10.3390/su151713186.

Mercader-Moyano, P., Camporeale, P.E. and Lopez-Lopez, J. (2022), "A construction and demolition waste management model applied to social housing to trigger post-pandemic economic recovery in Mexico", *Waste Management and Research*, Vol. 40 No. 7, pp. 1027-1038, doi: 10.1177/0734242x211052856.

Mhatre, P., Gedam, V.V. and Unnikrishnan, S. (2023), "Management insights for reuse of materials in a circular built environment", *Waste Management and Research*, Vol. 42 No. 5, pp. 396-405.

Mhlanga, J., Haupt, T.C. and Loggia, C. (2022), "Shaping circular economy in the built environment in Africa. A bibliometric analysis", *Journal of Engineering, Design and Technology*, Vol. 22 No. 2, pp. 613-642, doi: 10.1108/jedt-03-2022-0175.

Mihai, F.C. (2019), "Construction and demolition waste in Romania: the route from illegal dumping to building materials", *Sustainability*, Vol. 11 No. 11, p. 3179, doi: 10.3390/su11113179.

Mollaei, A., Bachmann, C. and Haas, C. (2023), "Estimating the recoverable value of in-situ building materials", *Sustainable Cities and Society*, Vol. 91, 104455, doi: 10.1016/j.scs.2023.104455.

Morón, A., Ferrández, D., Saiz, P. and Morón, C. (2021), "Experimental study with cement mortars made with recycled concrete aggregate and reinforced with aramid fibers", *Applied Sciences*, Vol. 11 No. 17, p. 7791, doi: 10.3390/app11177791.

Nie, P., Dahanayake, K.C. and Sumanarathna, N. (2024), "Exploring UAE's transition towards circular economy through construction and demolition waste management in the pre-construction stage–a case study approach", *Smart and Sustainable Built Environment*, Vol. 13 No. 2, pp. 246-266.

Noll, D., Wiedenhofer, D., Miatto, A. and Singh, S.J. (2019), "The expansion of the built environment, waste generation and EU recycling targets on Samothraki, Greece: an island's dilemma", *Resources, Conservation and Recycling*, Vol. 150, 104405, doi: 10.1016/j.resconrec.2019.104405.

Norouzi, M., Chàfer, M., Cabeza, L.F., Jiménez, L. and Boer, D. (2021), "Circular economy in the building and construction sector: a scientific evolution analysis", *Journal of Building Engineering*, Vol. 44, 102704, doi: 10.1016/j.jobe.2021.102704.

Oliveira, M.D.P.S.L., de Oliveira, E.A. and Fonseca, A.M. (2021), "Strategies to promote circular economy in the management of construction and demolition waste at the regional level: a case study in Manaus, Brazil", *Clean Technologies and Environmental Policy*, Vol. 23 No. 9, pp. 2713-2725, doi: 10.1007/s10098-021-02197-7.

Oluleye, B.I., Chan, D.W., Saka, A.B. and Olawumi, T.O. (2022), "Circular economy research on building construction and demolition waste: a review of current trends and future research directions", *Journal of Cleaner Production*, Vol. 357, 131927, doi: 10.1016/j.jclepro.2022.131927.

Oluleye, B.I., Chan, D.W., Antwi-Afari, P. and Olawumi, T.O. (2023), "Modeling the principal success factors for attaining systemic circularity in the building construction industry: an international survey of circular economy experts", *Sustainable Production and Consumption*, Vol. 37, pp. 268-283, doi: 10.1016/j.spc.2023.03.008.

Pani, L., Rombi, J., Francesconi, L. and Mereu, A. (2020), "Circular economy model of recycled aggregates for the construction sector of Sardinia island", *Environmental Engineering & Management Journal (EEMJ)*, Vol. 19 No. 10, pp. 1847-1855, doi: 10.30638/eemj.2020.177.

Papamichael, I., Voukkali, I., Loizia, P. and Zorpas, A.A. (2023), "Construction and demolition waste framework of circular economy: a mini review", *Waste Management and Research*, Vol. 41 No. 12, pp. 1728-1740, doi: 10.1177/0734242x231190804.

Ramos, M. and Martinho, G. (2021), "Influence of construction company size on the determining factors for construction and demolition waste management", *Waste Management*, Vol. 136, pp. 295-302, doi: 10.1016/j.wasman.2021.10.032.

Ramos, M., Martinho, G. and Pina, J. (2023a), "Strategies to promote construction and demolition waste management in the context of local dynamics", *Waste Management*, Vol. 162, pp. 102-112, doi: 10.1016/j.wasman.2023.02.028.

Ramos, M., Martinho, G., Vasconcelos, L. and Ferreira, F. (2023b), "Local scale dynamics to promote the sustainable management of construction and demolition waste", *Resources, Conservation and Recycling Advances*, Vol. 17, 200135, doi: 10.1016/j.rcradv.2023.200135.

Ratnasabapathy, S., Alashwal, A. and Perera, S. (2021), "Investigation of waste diversion rates in the construction and demolition sector in Australia", *Built Environment Project and Asset Management*, Vol. 11 No. 3, pp. 427-439, doi: 10.1108/bepam-01-2020-0012.

Rayhan, D.S.A. and Bhuiyan, I.U. (2023), "Review of construction and demolition waste management tools and frameworks with the classification, causes, and impacts of the waste", *Waste Disposal and Sustainable Energy*, Vol. 6, pp. 1-27, doi: 10.1007/s42768-023-00166-y.

Rigillo, M., Ermolli̇, S.R., Gallucci̇o, G., Pi̇cci̇ri̇llo, S., Tordo, S., Galdi̇, F. and Musto, M. (2022), "A process 'algorithm' for C&D materials reuse through file-to-factory processes", *Environmental Research and Technology*, Vol. 5 No. 4, pp. 340-348, doi: 10.35208/ert.1150743.

Rigillo, M., Galluccio, G. and Paragliola, F. (2023), "Digital and circularity in building. KETs for waste management in the European Union", *AGATHÓN| International Journal of Architecture, Art and Design*, Vol. 13, pp. 247-258.

Rodrigo, N., Omrany, H., Chang, R. and Zuo, J. (2024), "Leveraging digital technologies for circular economy in construction industry: a way forward", *Smart and Sustainable Built Environment*, Vol. 13 No. 1, pp. 85-116, doi: 10.1108/sasbe-05-2023-0111.

Ruiz, L.A.L., Ramón, X.R. and Domingo, S.G. (2020), "The circular economy in the construction and demolition waste sector–A review and an integrative model approach", *Journal of Cleaner Production*, Vol. 248, 119238, doi: 10.1016/j.jclepro.2019.119238.

Rybak-Niedziółka, K., Starzyk, A., Łacek, P., Mazur, Ł., Myszka, I., Stefańska, A., Kurcjusz, M., Nowysz, A. and Langie, K. (2023), "Use of waste building materials in architecture and urban planning—a review of selected examples", *Sustainability*, Vol. 15 No. 6, p. 5047, doi: 10.3390/su15065047.

Saeed, F., Mostafa, K., Rausch, C. and Hegazy, T. (2023), "Environmental impact and cost assessment for reusing waste during end-of-life activities on building projects", *Journal of Construction Engineering and Management*, Vol. 149 No. 10, 04023099, doi: 10.1061/jcemd4.coeng-12943.

Salleh, H., Ying, C.K., Hanid, M., Samad, Z.A., Sabli, N.A.M. and Khuzzan, S.M.S. (2022), "Development of guidance for the adoption of circular economy in construction and demolition waste management", *Planning Malaysia*, Vol. 20, doi: 10.21837/pm.v20i24.1216.

Santos, G., Esmizadeh, E. and Riahinezhad, M. (2023), "Recycling construction, renovation, and demolition plastic waste: review of the status quo, challenges and opportunities", *Journal of Polymers and the Environment*, Vol. 32 No. 2, pp. 1-31, doi: 10.1007/s10924-023-02982-z.

Sharma, N., Kalbar, P.P. and Salman, M. (2022), "Global review of circular economy and life cycle thinking in building Demolition Waste Management: a way ahead for India", *Building and Environment*, Vol. 222, 109413, doi: 10.1016/j.buildenv.2022.109413.

Shooshtarian, S., Caldera, S., Maqsood, T., Ryley, T. and Khalfan, M. (2022a), "An investigation into challenges and opportunities in the Australian construction and demolition waste management system", *Engineering, Construction and Architectural Management*, Vol. 29 No. 10, pp. 4313-4330, doi: 10.1108/ecam-05-2021-0439.

Shooshtarian, S., Caldera, S., Maqsood, T., Ryley, T., Wong, P.S. and Zaman, A. (2022b), "Analysis of factors influencing the creation and stimulation of the Australian market for recycled construction and demolition waste products", *Sustainable Production and Consumption*, Vol. 34, pp. 163-176, doi: 10.1016/j.spc.2022.09.005.

Shooshtarian, S., Maqsood, T., Caldera, S. and Ryley, T. (2022c), "Transformation towards a circular economy in the Australian construction and demolition waste management system", *Sustainable Production and Consumption*, Vol. 30, pp. 89-106, doi: 10.1016/j.spc.2021.11.032.

Shuvaiev, A., Arutiunian, I., Anin, V., Ichetovkin, A. and Sylenko, S. (2022), "Ensuring the economic and environmental efficiency in managing the flows of construction and demolition waste by using tools of economic and mathematical modeling", *Eastern-European Journal of Enterprise Technologies*, Vol. 117 No. 10, pp. 6-14, doi: 10.15587/1729-4061.2022.259537.

Sobotka, A. and Sagan, J. (2021), "Decision support system in management of concrete demolition waste", *Automation in Construction*, Vol. 128, 103734, doi: 10.1016/j.autcon.2021.103734.

Soto-Paz, J., Arroyo, O., Torres-Guevara, L.E., Parra-Orobio, B.A. and Casallas-Ojeda, M. (2023), "The circular economy in the construction and demolition waste management: a comparative analysis in emerging and developed countries", *Journal of Building Engineering*, Vol. 78, 107724, doi: 10.1016/j.jobe.2023.107724.

Soyinka, O.A., Wadu, M.J., Lebunu Hewage, U.W.A. and Oladinrin, T.O. (2023), "Scientometric review of construction demolition waste management: a global sustainability perspective", *Environment, Development and Sustainability*, Vol. 25 No. 10, pp. 10533-10565, doi: 10.1007/s10668-022-02537-7.

Takyi-Annan, G.E. and Zhang, H. (2023), "Assessing the impact of overcoming BIM implementation barriers on BIM usage frequency and circular economy in the project lifecycle using Partial least Squares structural Equation modelling (PLS-SEM) analysis", *Energy and Buildings*, Vol. 295, 113329, doi: 10.1016/j.enbuild.2023.113329.

Tefa, L., Bianco, I., Blengini, G.A. and Bassani, M. (2022), "Integrated and comparative Structural-LCA analysis of unbound and cement-stabilized construction and demolition waste aggregate for subbase road pavement layers formation", *Journal of Cleaner Production*, Vol. 352, 131599, doi: 10.1016/j.jclepro.2022.131599.

Torgautov, B., Zhanabayev, A., Tleuken, A., Turkyilmaz, A., Borucki, C. and Karaca, F. (2022), "Performance assessment of construction companies for the circular economy: a balanced scorecard approach", *Sustainable Production and Consumption*, Vol. 33, pp. 991-1004, doi: 10.1016/j.spc.2022.08.021.

Tsydenova, N., Becker, T. and Walther, G. (2021), "Optimised design of concrete recycling networks: the case of North Rhine-Westphalia", *Waste Management*, Vol. 135, pp. 309-317, doi: 10.1016/j.wasman.2021.09.013.

van den Berg, M., Hulsbeek, L. and Voordijk, H. (2023), "Decision-support for selecting demolition waste management strategies", *Buildings and Cities*, Vol. 4 No. 1, pp. 883-901, doi: 10.5334/bc.318.

Véliz, K.D., Ramírez-Rodríguez, G. and Ossio, F. (2022), "Willingness to pay for construction and demolition waste from buildings in Chile", *Waste Management*, Vol. 137, pp. 222-230, doi: 10.1016/j.wasman.2021.11.008.

Véliz, K.D., Walters, J.P., Busco, C. and Vargas, M. (2023), "Modeling barriers to a circular economy for construction demolition waste in the Aysén region of Chile", *Resources, Conservation and Recycling Advances*, Vol. 18, 200145, doi: 10.1016/j.rcradv.2023.200145.

Victar, H.C. and Waidyasekara, K.G.A.S. (2023), "Circular economy strategies for waste management in Sri Lanka: a focus on demolitions and repurpose and material recovery and production stages", *Waste Management and Research*, pp. 1-26, doi: 10.1177/0734242x231206988.

Villoria Sáez, P., Barbero-Álvarez, M.A., Porras-Amores, C., Álvarez Alonso, M. and García Torres, Á. (2023), "Design and validation of a mobile application for construction and demolition waste traceability", *Buildings*, Vol. 13 No. 8, p. 1908, doi: 10.3390/buildings13081908.

Wu, P.Y., Sandels, C., Mjörnell, K., Mangold, M. and Johansson, T. (2022a), "Predicting the presence of hazardous materials in buildings using machine learning", *Building and Environment*, Vol. 213, 108894, doi: 10.1016/j.buildenv.2022.108894.

Wu, W., Xie, L. and Hao, J.L. (2022b), "An integrated trading platform for construction and demolition waste recovery in a circular economy", *Sustainable Chemistry and Pharmacy*, Vol. 25, 100597, doi: 10.1016/j.scp.2022.100597.

Wuni, I.Y., Shen, G.Q. and Osei-Kyei, R. (2019), "Scientometric review of global research trends on green buildings in construction journals from 1992 to 2018", *Energy and Buildings*, Vol. 190, pp. 69-85, doi: 10.1016/j.enbuild.2019.02.010.

Yang, Y., Guan, J., Nwaogu, J.M., Chan, A.P., Chi, H.L. and Luk, C.W. (2022), "Attaining higher levels of circularity in construction: scientometric review and cross-industry exploration", *Journal of Cleaner Production*, Vol. 375, 133934, doi: 10.1016/j.jclepro.2022.133934.

Yu, S., Awasthi, A.K., Ma, W., Wen, M., Di Sarno, L., Wen, C. and Hao, J.L. (2022), "In support of circular economy to evaluate the effects of policies of construction and demolition waste management in three key cities in Yangtze River Delta", *Sustainable Chemistry and Pharmacy*, Vol. 26, 100625, doi: 10.1016/j.scp.2022.100625.

Zhang, K., Qing, Y., Umer, Q. and Asmi, F. (2023), "How construction and demolition waste management has addressed sustainable development goals: exploring academic and industrial trends", *Journal of Environmental Management*, Vol. 345, 118823, doi: 10.1016/j.jenvman.2023.118823.

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Appendix

Table A1.
Content analysis of selected articles

Author(s)	Published journal	Study scope	Location	Data source	Objective	Findings
Ramos *et al.* (2023a, b)	Waste Management	Strategies to promote CE for CDWM	Portugal	Fieldwork	To test strategies to overcome identified problems and understand factors contributing to success	Successful CE implementation can be facilitated by frequent monitoring, proper training, and awareness
Ma *et al.* (2023)	Sustainable Chemistry and Pharmacy	CSFs to deploy CE for CDWM	China	Interviews and Survey	To explore CSFs to adopt closed-loop CE for CDWM in China	CSFs for CDWM in a CE could overcome the present drawbacks of the 3R approach in China
Boateng *et al.* (2023)	Journal of Material Cycles and Waste Management	The environmental and economic outlook of CDWM practices	Fargo	Interview	To apply life cycle assessment (LCA) and life cycle costing (LCC) to evaluate benefits of CDWM	The study found that a 75% reduction in CDW can reduce 35% environmental burden and generate income of $61/ton
Ramos *et al.* (2023a)	Resources, Conservation & Recycling Advances	Management of construction and demolition wastes	Portugal	Interview	To understand the contribution of local scale dynamics in the promotion of CDWM from an operational perspective	Results reveal that strategies related to investment in local solutions improve the market for recycled aggregates
Kabirifar *et al.* (2023)	Applied Soft Computing	MCDM modeling for CDWM	Tehran	Interview and Survey	To identify and prioritize factors affecting CE implementation in the CDWM field	Results indicate that 'on-site sorting, reusing, waste recycling, and 'waste management plans/ regulations' are the most important factors
Meng *et al.* (2023)	Sustainability	Integration of Digital Twin and CE	Mixed countries	Interviews and Survey	To investigate CE implementation, as well as integration of digital twin and CE in CDWM	The digital twin has great potential to improve circular economy practice

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Author(s)	Published journal	Study scope	Location	Data source	Objective	Findings
Alite *et al.* (2023)	Journal of Material Cycles and Waste Management	Challenges and opportunities on the road to circular economy	Pristina	On-site visits	To identify instruments and policies of sustainable/circular CDW management system for Kosovo	The analysis identified gaps in Kosovo's CDWM and its enforcement of existing CDW legislation
Saeed *et al.* (2023)	Journal of Construction Engineering and Management	Environmental Impact and Cost Assessment for Reusing Waste	Canada	On-site visits	To propose a decision support framework (DSF) for managing construction waste generated during end-of-life activities	DSF is used to evaluate trade-offs for recovery planning activities
Véliz *et al.* (2023)	Resources, Conservation & Recycling Advances	Modeling barriers to CE for CDW	Chile	Survey	To analyze the interaction of inhibiting factors impacting CE-CDW	Limited policy and regulation as key barriers impacting financial and technical elements of CE-CDW adoption
Boonkanit and Suthiluck (2023)	Sustainability	Developing a Decision Support System for a Smart CDWM	Thailand	Interview	To develop a DSS to select the most appropriate concrete waste management method	The developed system helps in analyzing alternative solutions for CDWM
Oluleye *et al.* (2023)	Sustainable Production and Consumption	Modeling success factors for systemic circularity	Mixed	Survey	To evaluate the CSFs for attaining systemic circularity in the BCI	The EFA helps organize the CSF pool, and the FSE helps establish the significance level between the two economies
Villoria Sáez *et al.* (2023)	Buildings	Design a mobile application for CDWM	Madrid	Interview	To develop a hybrid mobile app for real-time traceability of construction waste management	The app allows estimation and tracing of the amount of CDW generated in real-time

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Author(s)	Published journal	Study scope	Location	Data source	Objective	Findings
Christensen *et al.* (2022)	Resources, Conservation & Recycling Advances	Closing the material loops for CDW	Denmark	Case study	To demonstrate practices and procedures for reusing and recycling CDW	The findings analyze and discuss economic and practical barriers
Rigillo *et al.* (2022)	Environmental Research and Technology	A process algorithm for C&D materials reuse	Italy	Case study	To identify the use of file-to-factory technologies in the reuse process of C&D materials	A process algorithm is designed for material reuse purposes in different contexts
Shooshtarian *et al.* (2022a, b, c)	Sustainable Production and Consumption	Factors influencing the market for recycled CDW	Australia	Interview	To propose a waste market development framework and provide solutions to overcome current barriers	The findings guide the government and practitioners in facilitating end markets for CDW
Cheng *et al.* (2023)	International Journal of Construction Management	Sustainable construction through CDWM practices	China	Published materials, Interview	To develop a systematic framework for analyzing internal and external CDWM conditions	The findings proposed five strategic recommendations for improving CDWM practices
Victar and Waidyasekara (2023)	Waste Management & Research	Circular economy strategies for CDW	Sri Lanka	Interview, Delphi technique	To focus on waste generation, reduction, and optimization of resources in building project life cycles	Findings reveal 14 issues for effective CDWM
Torgautov *et al.* (2022)	Sustainable Production and Consumption	Performance measures of the construction sector	Kazakhstan	Interview	To create a strategic framework to identify and select specific CE actions	The developed framework can measure CDW performance
Lin *et al.* (2022)	Journal of Environmental Management	Deep convolutional neural networks for CDW classification	China	Site visit, Google search	To develop an efficient method for sorting CDW using deep learning and knowledge transfer approaches	The proposed method enables automatic sorting of CDW

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Author(s)	Published journal	Study scope	Location	Data source	Objective	Findings
Shooshtarian *et al.* (2022a)	Engineering, Construction, and Architectural Management	An investigation into challenges and opportunities	Australia	Survey	To understand the challenges and opportunities of effective CDWM	The main barriers are "overregulation, lack of local market and culture, poor education, and low acceptance"
Luciano *et al.* (2022)	Sustainable Chemistry and Pharmacy	Issues hindering widespread CDW recycling practice	Mixed	Desk research, survey, and interview	To discuss the issues hindering widespread CDW recycling practice	Difficulties have been analyzed and suggestions provided to improve waste recycling and reuse
Véliz *et al.* (2022)	Waste Management	Willingness to pay for CDW	Chile	Survey	To analyze the willingness of companies to pay attention to improving CDWM	The outcome found a greater quantity of inert and non-inert wastes
Wu *et al.* (2022b)	Sustainable Chemistry and Pharmacy	Trading platform for CDW recovery	China	Survey	To investigate the trading platform for CDWM	Findings compared the time delay of two kinds of CDW transaction processes
Wu *et al.* (2022a)	Building and Environment	Predicting the presence of hazardous materials	Sweden	Records register	To highlight challenges in machine learning pipeline development	Models perform well on limited datasets; the model's generalizability could be improved by collecting more data
Mercader-Moyano *et al.* (2022)	Waste Management & Research	CDWM model applied to social housing	Mexico	Survey, and Case Study	To quantify on-site 61 Mexican social housing CDW	Findings reveal that social housing consumes 1.24 tm and produces 0.083 tm of CDW
Guo *et al.* (2022)	Sustainable Production and Consumption	Sustainable development of CDW recycling systems	China	Case study	To develop a four-party evolutionary game model	Using this model, companies promote the sustainable development of CDWR systems

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Table A1.

Table A1.

Author(s)	Published journal	Study scope	Location	Data source	Objective	Findings
Salleh *et al.* (2022)	Planning Malaysia	CE adoption guidance in CDWM	Malaysia	Survey	To develop the strategy for the adoption of CE for CDWM	Developed strategies can improve the performance of the current CDWM system
Shuvaiev *et al.* (2022)	Eastern-European Journal of Enterprise Technologies	Managing the flows of CDW	Ukraine	Scientific and practical records	To manage CDW flows and examine the environmental and economic efficiency of the process	Proposed mathematical modeling could solve practical tasks effectively manage CDW flows
Ma *et al.* (2022)	Waste and Biomass Valorization	Evaluating the Carbon Emissions of CDW	China	Case study	To provide a causal loop model for evaluating the carbon emissions of CDW	Five causal loops are developed for evaluating the life cycle of CDW
Liu *et al.* (2021)	Journal of Cleaner Production	Explore barriers of CE in CDW recycling	India	Interview and Survey	To examine barriers to CE practices in the Indian construction industry	Findings reveal that Political, Social, and Economic category barriers affect CE adoption in emerging economies
Tsydenova *et al.* (2021)	Waste Management	Optimized design of concrete recycling networks	Germany	Case study	To develop a DSS to investigate the economic impacts of recycling concrete from building demolition	RC aggregates are economically viable predominantly in areas without local supplies of natural aggregates
Cristiano *et al.* (2021)	Journal of Cleaner Production	CDW in the Metropolitan City	Italy	Case study, Public databases	To provide useful feedback to stakeholders and administration to improve CDWM flows	The transition to CE in the concerned region is still at an early stage due to several weaknesses
Iodice *et al.* (2021)	Waste Management	Sustainability assessment of CDWM	Italy	Case study	To focus on the socio-economic and environmental implications of the CDWM	The practices and socio-environmental benefits of selective demolition are significant

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Author(s)	Published journal	Study scope	Location	Data source	Objective	Findings
Lachat *et al.* (2021)	Sustainability	From buildings' end of life to aggregate recycling	France	Case Study	To present a life cycle inventory compilation and assessment study of two buildings	The results indicate that the transport of waste, and its treatment are the most impactful phases
Davis *et al.* (2021)	Automation in construction	Classification of CDW	Australia	Case study	To identify and design CDW classifications using digital images of waste deposited in a construction site	This approach emulates authentic construction site scenarios where on-site sorting is difficult
Oliveira *et al.* (2021)	Clean Technologies and Environmental Policy	Strategies to promote CE in the CDWM	Brazil	Case study	To identify strategies for CDWM at the regional level	These strategies were successfully operationalized through a case study
Luciano *et al.* (2021)	Environmental Science and Pollution Research	CD recycling unified management	Italy	Case study	To develop an approach for managing CD projects to ensure compliance with technical standards and environmental criteria	This platform promotes an informed and transparent use of recycled products
Esguícero *et al.* (2021)	Journal of Material Cycles and Waste Management	CDW management process modeling	Brazil	Interview, Direct observation	To develop a framework for managing CDWM processes	The framework could improve the quality of recycled products
Condotta and Zatta (2021)	Journal of Cleaner Production	Reuse of building elements in the architectural practice	Europe	Interview, Desk Study, and Activity Analysis	This study discusses possible improvements of a circular built environment	The examined regulatory context highlights how the reuse of building elements
Sobotka and Sagan (2021)	Automation in Construction	Decision support system in CDWM	Poland	Interview	To develop a model to support decision-making in concrete waste management	The model explains the management of concrete waste by recovery or disposal
Mihai (2019)	Sustainability	CDW in Romania	Romania	Reports, Field observations	The paper performs a critical overview of the CDWM issues	The paper reveals the poor monitoring of CDW flows across Romanian counties

(*continued*)

Table A1.

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Author(s)	Published journal	Study scope	Location	Data source	Objective	Findings
Noll *et al.* (2019)	Resources, Conservation, and Recycling	Waste generation and EU recycling	Greece	Field survey, Interview	To develop a dynamic stock-driven model for different infrastructure and building types	Our results show that the material stock expanded from 175 t/cap to 350 t/cap, leading to an increase in annual CDW generation
Ghaffar *et al.* (2020)	Journal of Cleaner Production	Pathways to Circular Construction	United Kingdom	Interview	To investigate current practices of CDWM and circular construction	The study revealed that government legislation on the reuse and recycling threshold for every new project
Jayasinghe and Waldmann (2020)	Sustainability	Development of a BIM-based web tool	Luxembourg	Source data	To propose a BIM-based system to effectively manage the recycled materials and reused components	This system can extract the materials and component information of a building
Bao and Lu (2020)	Science of the Total Environment	Efficient circularity for CDWM	China	Case study, Site investigations, Interview	This study reports lessons learned from China, which developed an effective CDW circular economy from a low base	The study findings can be used as a reference for other economies in developing effective circularity
Huang *et al.* (2018)	Resources, Conservation, and Recycling	CDWM through the 3R principles	China	Interview	To investigate existing policies and management situations and analyze based on 3R principles	The primary barriers and key challenges are identified to improve the current situation based on 3R principles
Mahpour (2018)	Resources, conservation, and recycling	Prioritizing barriers to adopting CE in CDWM	Iran	Survey	To identify and classify the barriers of CE in CDWM	The study classified barriers into three different categories: behavioral, technical, and legal

Source(s): Table created by authors